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THE COMPETITIVE CHALLENGE FACING THE EUROPEAN AUTOMOTIVE COMPONENTS INDUSTRY

Executive Summary

January 1991

author →

BOSTON CONSULTING GROUP

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THE COMPETITIVE CHALLENGE FACING THE EC AUTOMOTIVE COMPONENTS INDUSTRY

Prepared

for

The Commission of the European Community,
Directorate General for Internal Market and Industrial Affairs

The Boston Consulting Group Ltd
Devonshire House
Mayfair Place
London W1X 5FH

PRS Consulting International Ltd
100 Hatton Garden
London EC1N 8NX

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FOREWORD

This executive summary contains the main analyses and recommendations of an extensive study of the size, structure and competitiveness of the EC automotive components industry. The study addressed the key structural changes and competitive strategies necessary to strengthen the competitiveness of the EC industry. It was carried out by the Boston Consulting Group (BCG) and PRS Consulting International during 1990.

The study investigated components for passenger car and light commercial vehicles less than 3.5 tonnes and covered parts both for original equipment and replacement. Product groups covered were the fuel system, cooling system, internal engine components, exhaust system, transmission and other drivetrain, suspension, steering, body and external parts, interior trim, brakes and electrical componentry. Paint, adhesives, fasteners, communications equipment, tyres, unfinished components and materials, accessories, care products were excluded from detailed analysis.

The study is based on approximately 150 face-to-face interviews with European component companies, all the major European vehicle manufacturers, a number of Japanese and US component and vehicle manufacturers, and experts and industry institutions in Europe, the US and Japan. Additionally, a survey based on a mailed questionnaire was carried out. More than 400 completed questionnaires were analysed and used to quantify insights gained from in-depth interviews.

The detailed results of the study are included in two volumes which have been handed over to the Commission of the European Community. Results of the study were presented to the Commission, CLEPA, CCMC and CLCA in the course of three formal presentations of one day each, in addition to informal meetings with the EC authorities and industry organisations.

The appendix to this summary contains the main conclusions of an additional study on the automotive components industry of Eastern Europe carried out by the Boston Consulting Group on behalf of the Directorate General for Internal Market and Industrial Affairs.

THE COMPETITIVE CHALLENGE FACING THE EC AUTOMOTIVE COMPONENTS INDUSTRY

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INTRODUCTION AND OBJECTIVES

The present study examines the size, structure, competitiveness, and main trends affecting the EC automotive components industry, including the Single European Market, technology, competitive position, policy environment and recent developments in Eastern Europe. The study covers not only diagnosis but also develops strategic and operational guidelines for improving the competitive position of the European industry.

The study consists of six main aspects:

- Sizing of EC automotive components demand and supply,
- Analysis of industry structure,
- Analysis of financial performance,
- Analysis of competitiveness,
- Analysis of key industry trends,
- Development of policy and strategic guidelines to improve competitiveness.

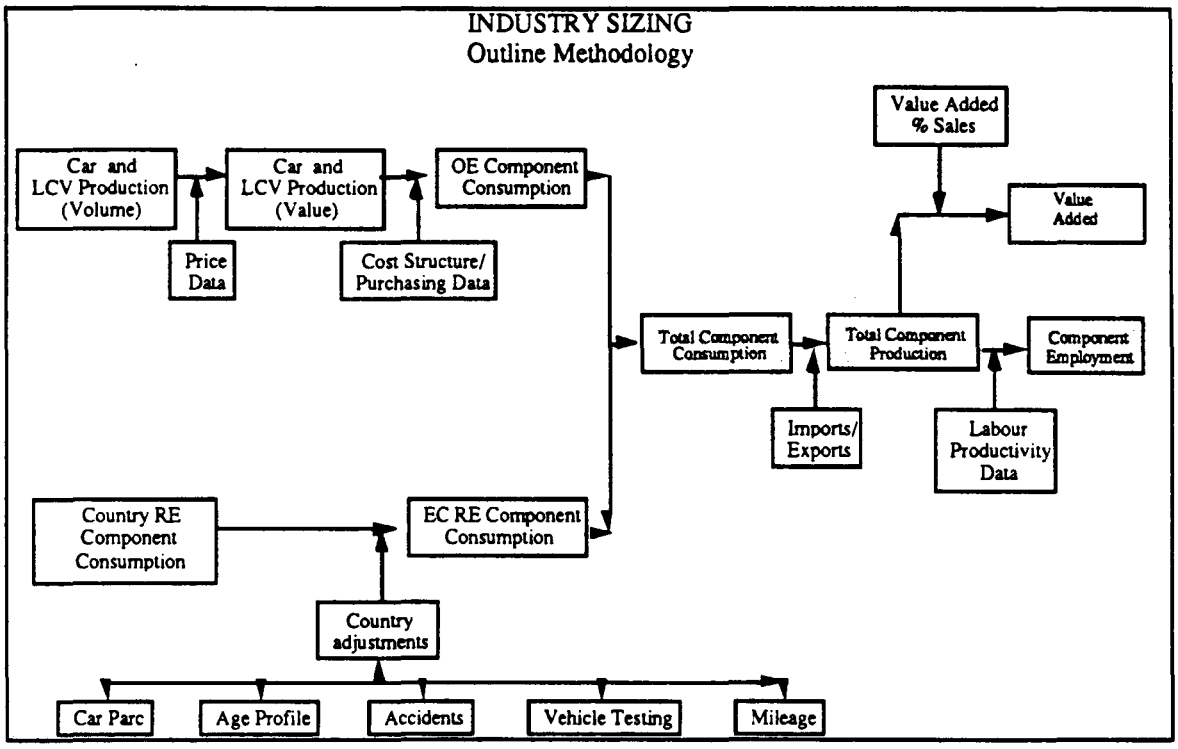
The recommended measures to improve competitive position have been based on an investigation of the structural and operational determinants of competitiveness and the current position of producers in the EC relative to key competitor countries in the main product areas. This study is addressed to component companies, vehicle manufacturers, the authorities of the European Community and industry institutions. It aims at providing guidelines for:

- Actions to be taken by component firms and the vehicle manufacturers,
- Actions to be taken at industry level by its institutions,
- Supporting policies.

The following sections summarise the main diagnoses and conclusions of the study. For full details, the two accompanying volumes should be consulted.

INDUSTRY SIZE

The previously existing published statistics on the size of the EC automotive components industry present a number of serious problems including incomplete coverage, inconsistent definitions, double counting, and confusion regarding price levels. Given such problems, an analytical approach was adopted for quantifying and forecasting component consumption, production, value-added and employment, based on explicit assumptions (derived from interviews and empirical data) on each element of demand. The chart below outlines the approach taken.



Car and light commercial vehicle (LCV) production values are based on production volume and price data. Component demand for original equipment vehicle manufacture (OE demand) was estimated from vehicle production value using information about vertical integration and production cost structure obtained from vehicle manufacturer interviews and other data.

Replacement component demand (RE demand) is relatively well documented in some EC countries. Demand in other EC countries was modelled by adjusting for country differences not only in parc size, but also parc age structure, average annual milage, accident rates, and the strictness of compulsory vehicle testing. Replacement market demand was assumed to consist of three elements driven by accidents, testing and mileage. Their relative magnitudes were derived from unpublished automotive insurance data, vehicle testing statistics and other sources.

From total component comsumption demand were derived production, value added and employment using EC trade data, labour productivity and value added statistics.

EC component production, consumption and value added were estimated at ECU 79 Bn, 71 Bn and 33 Bn respectively, all expressed in 1988 values . Replacement market demand

was calculated at 24% of total autocomponent consumption. Employment was calculated at 950,000 or 2.6 % of total EC industrial employment:

INDUSTRY SIZING
1988 Independent Autocomponents Production, Value Added, Consumption and Employment by Country

Country	Production		Value Added		Consumption		Employment	
	ECU 88 Bn	%	ECU 88 Bn	%	ECU 88 Bn	%	'000	%
Germany	30.6	39.0	14.5	44.3	23.5	33.1	329.1	34.6
France	16.9	21.5	5.7	17.3	15.2	21.5	168.7	17.8
Italy	11.1	14.1	4.5	13.7	9.2	13.0	138.5	14.6
Spain	8.8	11.2	3.6	10.9	9.3	13.1	147.1	15.5
UK	8.2	10.5	3.3	10.2	9.1	12.8	132.6	14.0
Belgium/ Luxembourg	1.4	1.8	0.6	1.7	2.0	2.9	13.8	1.5
Holland	0.4	0.5	0.2	0.5	1.2	1.7	3.8	0.4
Denmark	0.4	0.5	0.2	0.5	0.3	0.4	5.1	0.5
Portugal	0.4	0.5	0.2	0.5	0.6	0.8	7.0	0.7
Greece	0.2	0.2	0.1	0.2	0.4	0.5	3.0	0.3
Ireland	0.1	0.1	0.0	0.1	0.1	0.1	1.3	0.1
Total	78.5	100.0	32.7	100.0	70.9	100.0	950.0	100.0

Five countries (Germany, France, Italy, Spain and UK) account for over 90% of total production, value added, consumption and employment.

Germany's importance within the EC autocomponent industry is even greater than in vehicles; it accounts for 35% of vehicle production but 39% of component production, and 44% of value-added given the generally greater technological content of German production. These figures exclude the impact of German unification which has clearly further enhanced Germany's dominance.

Production and consumption are comparable with the upper range of previous estimates although the proportion attributable to the replacement market is somewhat smaller at 24%. Previous estimates may have exaggerated replacement market demand by incompletely excluding service and accessories and by comparing replacement market demand at retail price levels with OE demand at producer price levels.

Employment is somewhat higher than previous estimates, especially in Germany, Italy and Spain due perhaps to industry fragmentation and related data gathering problems.

The study analysed OE and replacement market consumption and production by the main component groups. The results are shown in the following table:

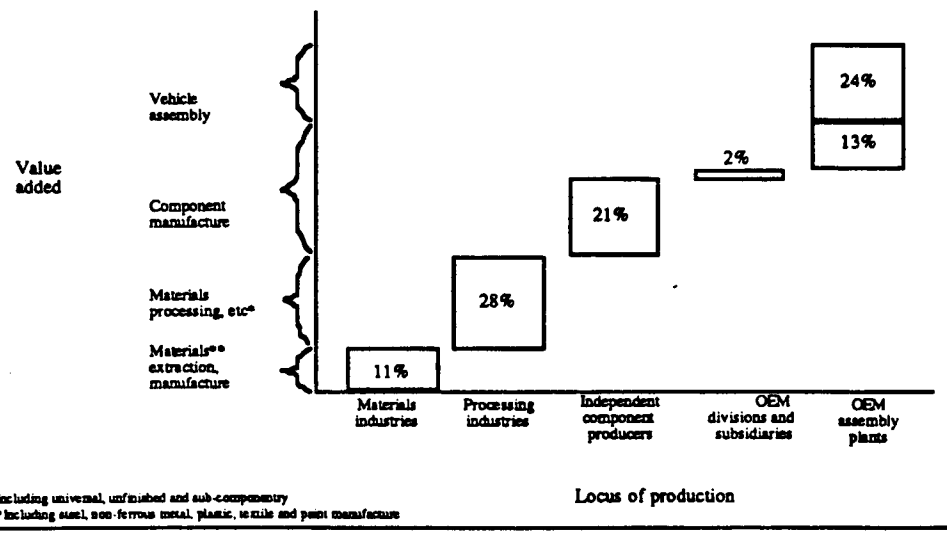
INDEPENDENT AUTOCOMPONENTS PRODUCTION AND CONSUMPTION BY COMPONENT TYPE

Type	Production		Consumption	
	(ECU 88 Bn)	(%)	(ECU 88 Bn)	(%)
Body	14.2	18.1	13.2	18.6
Electrical	12.3	15.6	12.1	17.1
Internal engine	9.2	11.8	7.7	10.9
Interior	8.5	10.8	8.3	11.7
Transmission	2.3	3.0	1.9	2.6
Other drive train	5.7	7.3	5.5	7.8
Brakes	5.0	6.4	4.5	6.4
Suspension	4.7	5.9	4.6	6.5
Wheels	4.3	5.5	4.0	5.6
Fuel	3.4	4.4	2.8	3.9
Engine cooling	2.6	3.3	1.9	2.7
Exhaust	2.6	3.3	2.4	3.5
Other*	1.8	2.3	-	-
Total	78.5	100.0	70.9	100.0

*Arising from residual categories in trade statistics

These size estimates relate to the independent autocomponents industry; it excludes components for commercial vehicles above 3.5 tonnes, the component subsidiaries of vehicle producers, component production at the site of vehicle assembly and also materials and processing industries supplying the components and vehicle producers. An attempt was made to place the independent components industry within a wider auto industry context. The diagram below shows that the independent autocomponents industry accounts for approximately 21% of total value added by the automotive industry (excluding vehicle distribution and repair).

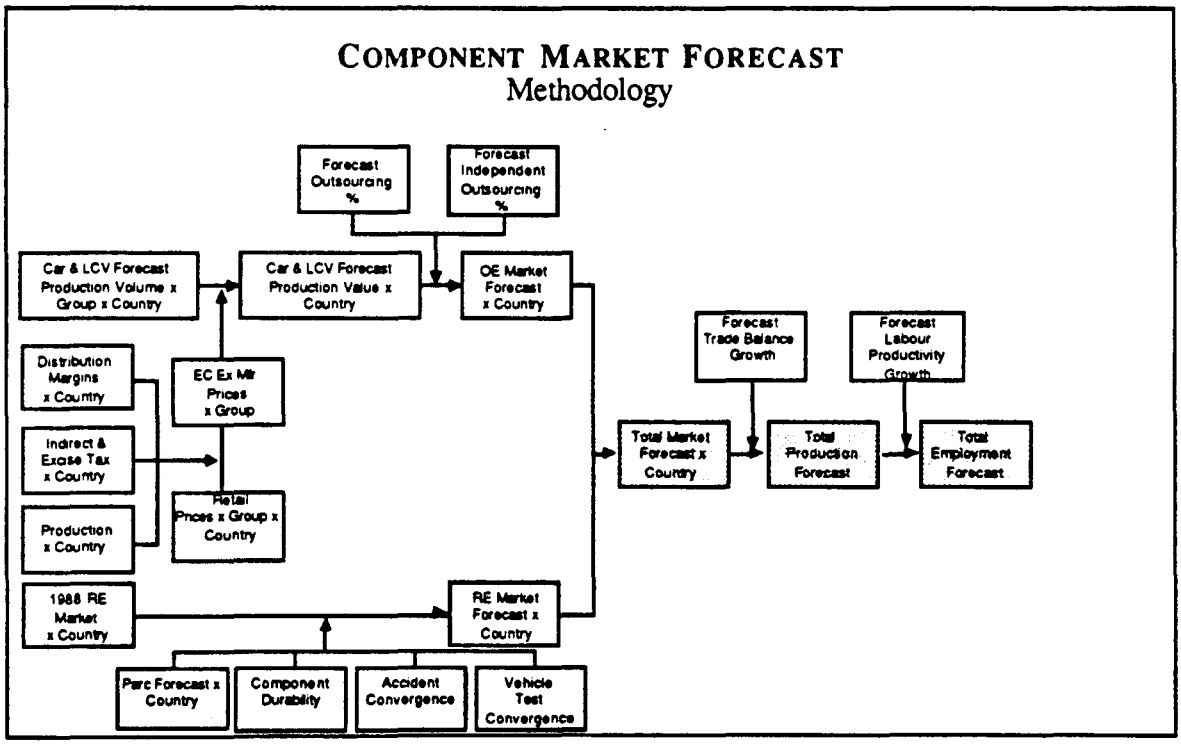
THE INDEPENDENT COMPONENTS INDUSTRY CONTRIBUTES APPROXIMATELY 21% OF THE TOTAL VALUE ADDED BY THE AUTOMOTIVE INDUSTRY



Employment in the independent components industry is estimated at 950,000, representing 38% of total auto industry employment. Including autocomponent production within subsidiaries and plants of vehicle producers, employment is estimated at over 1.6 million or more than 4% of total EC industrial employment. Total automotive industry related employment, including car assembly itself (approximately 90,000), materials, and processing industries, is estimated at roughly 2.5 million.

Forecast

The approach taken to forecasting industry growth is illustrated below. OE demand was derived from vehicle production forecasts and predictions about changes in vehicle manufacturers' level of vertical integration obtained from interviews. Replacement market demand was calculated from forecast parc growth and assumptions about changes in component durability and convergence in the vehicle testing requirements of EC countries. Production and employment forecasts were obtained from consumption forecasts using trade balance and labour productivity growth projections. (No allowance was made for the impact of developments in Eastern Europe, which are described in a separate report.)



Over the next five years, component production and consumption are forecast to grow on average at 2.7% per annum in real terms (net of inflation). This is faster than the projected vehicle production growth of 1.6% pa, the difference being attributable to a reduction in the degree of vertical integration forecast by EC vehicle manufacturers, resulting in greater purchases from EC independent component producers.

Replacement market demand is forecast to decline at 0.9% pa in real terms due to assumed improvements in component quality and reliability, based on component manufacturer interviews and analysis of historical trends in component durability.

Employment is forecast to decline at 1.3% pa compound due to improvements in labour productivity (5.4% pa) within the range of historical productivity improvements and necessitated by increased competition with Japanese companies.

Growth forecasts were tested for sensitivity to changes in major assumptions. Forecast market growth is most sensitive to assumptions about changes in the level of vertical integration by vehicle manufacturers, that is the proportion of sales outsourced and the proportion of the same which is independently outsourced. Changes in industry boundaries are the most critical determinant of independent component sector growth.

Given the relatively small proportion of total component consumption accounted for by compulsory vehicle testing, growth forecasts are relatively insensitive to changes in assumptions concerning the strictness and nature of testing requirements. Even major harmonisation of testing requirements across countries to the strictest levels in the EC would not have a large impact on autocomponent growth.

Forecast growth is only moderately sensitive to changes in assumptions concerning increased component durability growth. Forecast consumption and production decline by 0.2% for each 10% increase in component durability assumed over the 5 year period.

INDUSTRY STRUCTURE

The analysis of the *structure* of the EC autocomponents industry both provides insights into the *competitiveness* of the component industry and the entire vehicle value chain.

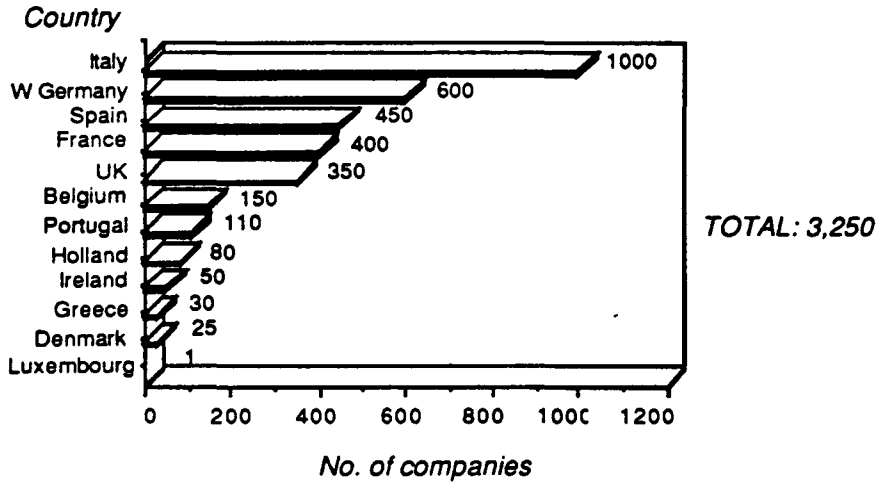
Comparable statistics across countries are not available from public sources. This required the use of a variety of sources and approaches to determine the structure of the industry. Data sources included national statistics, trade associations, the International Labour Office, published industry studies, the European Commission, and PRS databases.

In the following paragraphs the structure of the European industry is analysed in terms of company structure, regional concetration, degree of vertical and horizontal integration and the nature and number of direct suppliers to the vehicle manufacturers, and ownership and foreign investment.

Company Structure

The number of independent component companies in the European Community is estimated at 3,250, with the break-down by country shown below:

ESTIMATED NUMBER OF EC AUTOCOMPONENT SUPPLIERS BY COUNTRY *

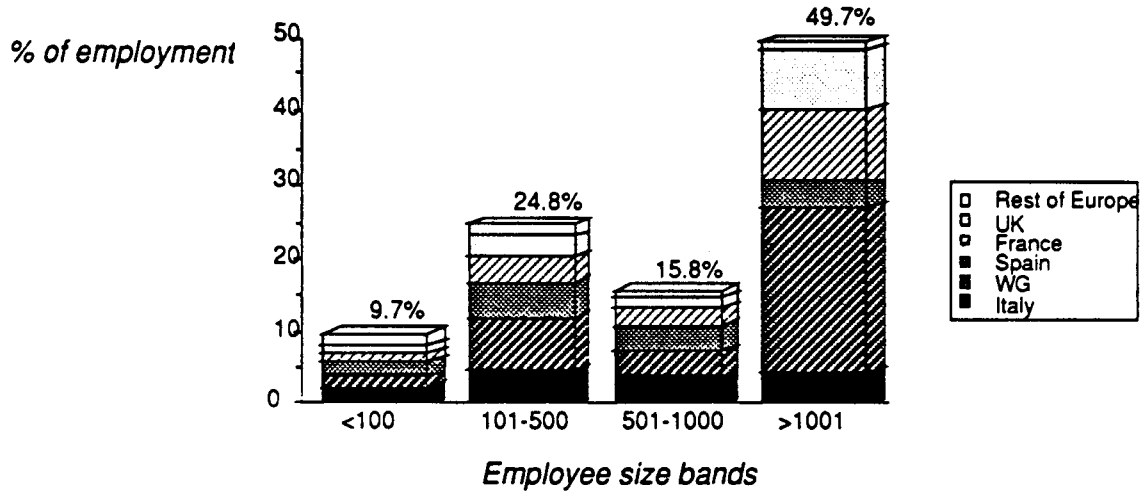


*1988

Source: Government Statistics, Trade Associations, PRS Analysis

Analysis of employment concentration indicates that companies with over 1,000 employees account for nearly 50% of total employment whilst 35% are employed by companies of less than 500, the definition of Small and Medium Enterprises (SMEs) in the EC that are potential recipients of a number of Community policy initiatives.

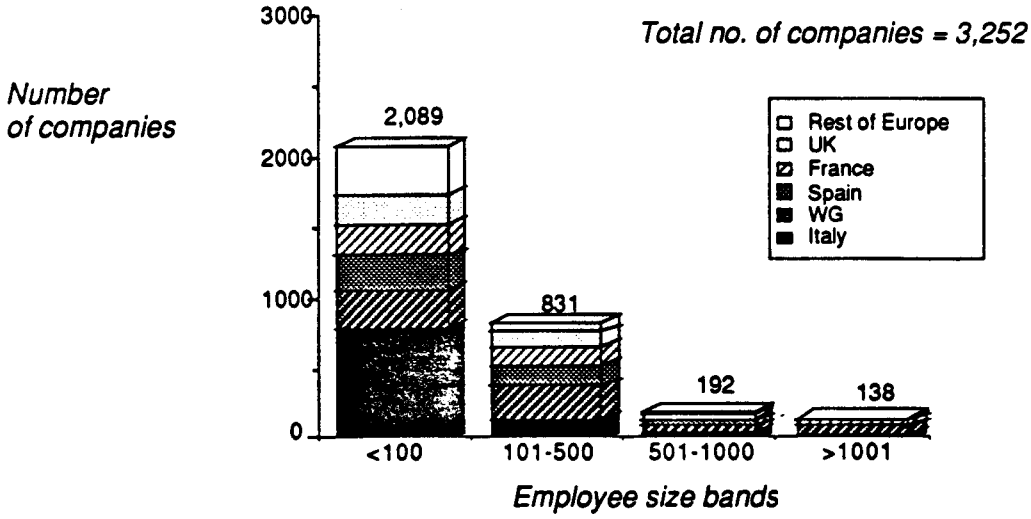
EC OVERVIEW OF TOTAL AUTOCOMPONENT EMPLOYMENT SHOWN BY EMPLOYEE SIZE BANDS 1988



Source: Government Statistics, Trade Associations, PRS Analysis

Companies with employment in excess of 1,000 people, which account for almost half of total industry employment, are relatively few in the EC (138), whilst the number of companies in the size band below 100 employees is more than 2000. 2,900 companies fall under the definition of SMEs.

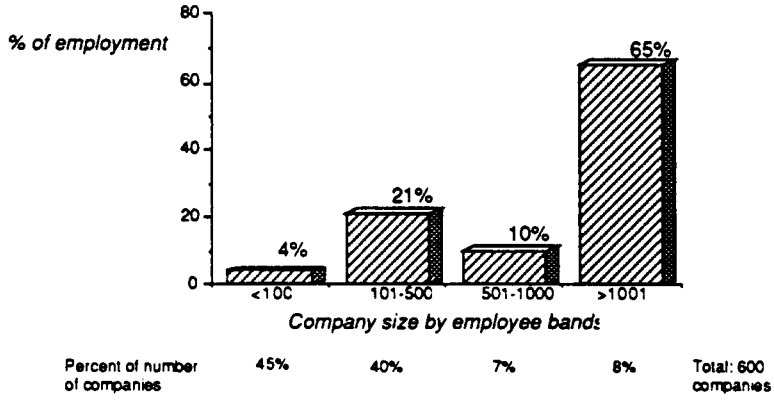
EC OVERVIEW OF ESTIMATED NUMBER OF AUTOCOMPONENT COMPANIES SHOWN BY SIZE BANDS



Source: Government Statistics, Trade Associations, PRS Analysis

There are significant differences in the industry structure of the key producer countries. Whilst West Germany, France and the UK are relatively concentrated, Italy and Spain show a greater degree of fragmentation. Two-thirds of West German component industry employment is in companies with more than 1,000 employees:

WEST GERMAN AUTOCOMPONENT EMPLOYMENT SHOWN BY EMPLOYEE SIZE BANDS 1988



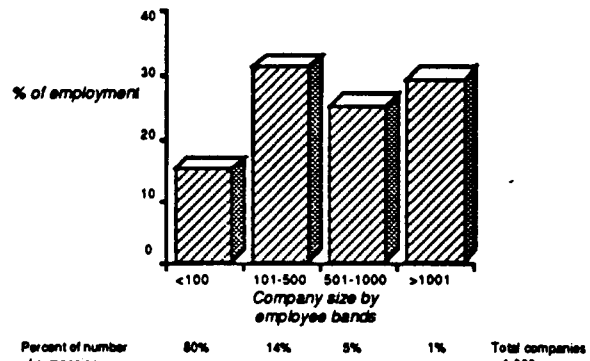
Source: VDA/PRS Analysis

West Germany has the highest employment concentration in the top size band (65% of the employees are in 8% of the number of companies). Eight West German companies (Bosch, Teves, ZF, VDO, Behr, Siemens Bendix, Fichtel & Sachs, and Hella) are amongst the top 20 suppliers in the EC ranked by automotive sales. All are world leaders in specific product areas and have a strong presence in high technology sectors such as electronics and transmissions.

Similarly, 60% of employment in the UK and 59% in France is accounted for by the 7% of companies in each country with over 1,000 employees. The UK has a relatively high number of major EC autocomponent companies (Lucas, GKN, Pilkington, BBA, T&N and BTR) which reflects strength in traditional automotive areas and the shake out of smaller companies in the early 1980s. 30% of UK and 27% of French employment is concentrated in SMEs.

Italy and Spain, however, have a very different industry structure: around half of the employment is accounted for by small and medium sized enterprises. SMEs account for 94% of the total number of enterprises in Italy and 46% of employment.

ITALIAN AUTOCOMPONENT EMPLOYMENT SHOWN BY EMPLOYEE SIZE BANDS 1988



Source: Anfia/PRS Analysis

The Italian industry structure, is skewed, however, since the large company sector is limited to a very small number of companies. Fewer than 1% of Italian companies, chiefly the Magnetti Marelli Group, account for 29% of total employment in the sector.

The proportion of employment concentrated in SMEs in Spain is slightly higher than that of Italy at 50%. Although the top 3% of Spanish enterprises account for approximately one quarter of Spanish employment, there are no dominant Spanish suppliers. Larger companies tend to be foreign-owned subsidiaries. The largest companies are FEMSA (Bosch, WG), Bendix España (US) and United Technologies MAI (US).

The top 20 autocomponent companies in the EC, ranked by automotive turnover, are given in the following table:

	Company Name	Autocomponent Turnover ECU m (1988)	Percentage Automotive Components	Country of ultimate ownership
1.	Bosch	3421	54	W Germany
2.	Valeo	2340	100	France
3.	Magnetti Marelli	1950	100	Italy
4.	GM-ACG (Europe)	1669	100	USA/France
5.	Lucas Automotive	1810	100	UK
6.	GKN	1645	58	UK
7.	Teves	1173	100	USA/W Germany
8.	Pilkington	1149	33	UK
9.	BBA Group	1042	69	UK
10.	T&N	955	61	UK
11.	Allied-Signal*	918	38	US
12.	ZF	896	39	W Germany
13.	VDO	771	80	W Germany
14.	BTR	675	64	UK
15.	Hutchinson	647	46	France
16.	Behr	542	100	W Germany
17.	Siemens (Bendix)	762	3	W Germany
18.	ECIA	511	100	France
19.	Fichtel & Sachs	476	70	W Germany
20.	Hella	470	70	W Germany

* Excludes Bendix Electronics
Source: PRS Analysis

These 20 companies account for approximately 25% of total EC autocomponent employment. The activities of the top 20 companies reflect the European lead position in automotive electronics, brakes, fuel systems and transmissions. Three of the top 20 are closely associated with major OEMs (Magnetti Marelli, ACG and ECIA).

The rest of Europe has very few large companies. Those with over 1,000 employees are Solvay (Belgium), Cablesa (Portugal), Philips Lighting and the Hoogovens Group (Holland) and Roulands (Denmark).

The smaller supplier countries have a greater single product focus with a tendency to specialise in electrical products and wiring harnesses in particular (eg Ireland and Portugal), reflecting factor cost positions and regional investment incentives.

Regional concentration and location

36% of total autocomponents employment is estimated to be in regions eligible for Community structural action, with 6% of this under objective 1 and 5% under objective 2:

EC AUTOCOMPONENT EMPLOYMENT BY REGIONS ELIGIBLE FOR COMMUNITY STRUCTURAL ACTION

Country	Objective 1	Objective 2 Totally eligible	Objective 3 Partially eligible	Total	% of employment in areas eligible for structural action
Spain	17.0	12.0	90.0	119.0	100%
UK	2.0	16.0	44.5	62.5	52%
Italy	9.0	-	32.0	41.0	32%
France	-	3.0	34.0	37.0	25%
W Germany	-	14.0	12.0	26.0	8%
Portugal	15.0	-	-	15.0	100%
Ireland	6.6	-	-	6.6	100%
Belgium	-	0.2	3.0	3.2	19%
Holland	-	-	2.5	2.5	28%
Greece	1.0	-	-	1.0	100%
Luxembourg	-	-	0.2	0.2	100%
Denmark	-	-	0.06	0.06	2%
Total	50.6	45.2	218.2	314.0	35%

Areas eligible for Community structural action typically correspond to those regions with little vehicle manufacture or with assembly operations only (eg Ireland and Portugal). The main areas of vehicle assembly concentration which attract considerable component industry concentration tend to be outside the areas eligible for regional funds: West Germany, Paris, Turin. On the other hand Spain, Southern Portugal and Italy have key components industries in areas covered by objectives 1 and 2.

OEM component purchasing is currently highly nationally focused. Mercedes Benz, for example, purchases 90% of outsourced components domestically, Volkswagen 80% and Fiat 88%. A number of factors are likely to reduce the current tendency towards domestic purchasing, such as the reorganisation of OEM purchasing functions on an European basis, the increased establishment of vehicle and component manufacture in Southern Europe allowing Northern European assemblers to take advantage of lower labour costs and investment incentives, and improved infrastructure.

The 1992 programme will facilitate Europeanisation of purchasing generally through reduced transport cost (savings of up to 20% are likely from transport deregulation and elimination of border formalities) and the elimination of bureaucratic obstacles. OEMs and component manufacturers generally do not believe that the 1992 programme in itself will lead to major changes in their location decisions as relates to their manufacturing operations. This is because those factors leading to greater Europeanisation of purchasing are often counterbalanced by the trend toward greater use of just-in-time systems, which favours close proximity of component companies to vehicle assembly plants. The Single Market programme is however changing companies' policies in aftermarket distribution structures substantially, with a number of vehicle producers rationalising their logistics systems on a Pan-European basis.

Vertical integration and car assembler relationships

Industry structure assumes significance in determining industry competitiveness when the entire value chain is analysed. Two elements are crucial:

- Value added by component companies vs car assemblers:
- The number of direct suppliers to car assemblers.

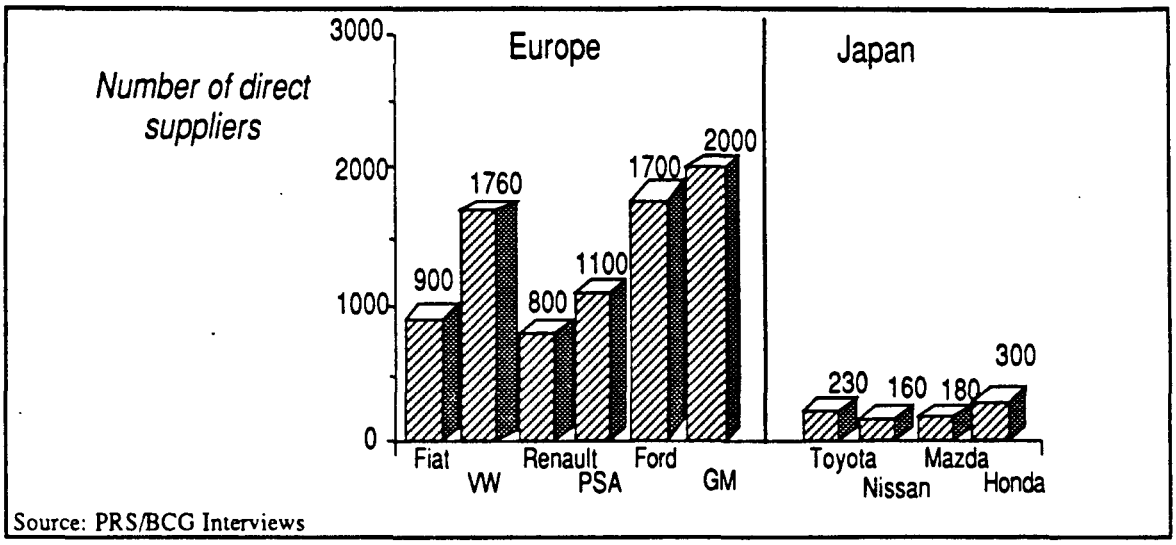
The first element is critical in reducing management complexity and costs at the OEM level and in concentrating R&D and logistics skills with strong component suppliers, capable of sustaining a major R&D effort. Greater value added at the component supplier level often implies that car manufacturers outsource assembled component subsystems or systems, giving significant advantages in supplier management. As is illustrated in the table below, *EC car manufacturers typically have a higher degree of vertical integration than Japanese OEMs*, particularly if component divisions and subsidiaries are taken into account. On average, value added as a percentage of sales in European OEMs is 46% without component subsidiaries and 56% including them, whilst Japanese OEMs are far less vertically integrated with only 36% of total value added (the effective level of integration in Japan may be somewhat higher given financial affiliation and close operational coordination with key suppliers):

DEGREE OF OEM VERTICAL INTEGRATION

OEM	Value added/sales %	Value added/sales % including component divisions
Fiat	36	51
VAG	60	60
Renault	55	60
Ford	40	55
GM	40	65
Mercedes	50	51
PSA	45	53
Honda	42	
Mazda	32	
Toyota	38	
Nissan	34	

Source: PRS/BCG interviews

The second key structural variable is the number of direct suppliers to assemblers. *One of the key structural differences between the European and the Japanese industry is the fact that Japanese assemblers have a much smaller number of direct suppliers.* As shown below, European volume car companies have between 800 and 2000 direct suppliers, whilst Japanese OEMs have between 160 and 300 direct suppliers. EC OEMs are gradually reducing their number of direct suppliers by reducing the number of suppliers per part and increasing the number of parts supplied by individual suppliers, but have still a significantly higher number of direct suppliers than the main Japanese car manufacturers.



Source: PRS/BCG Interviews

The greater level of concentration of component suppliers with direct contacts with the vehicle manufacturers does not necessarily imply a radical reduction in the number of independent component producers. Many will survive as second or third tier suppliers to the component producing complete systems or subsystems.

The advantage of a lower number of direct suppliers is again in simplification of management, coordination and increased responsibility of component suppliers to:

- Supply a larger number of components per component company;
- Supply assembled component systems and subsystems instead of a large number of individual components;
- Carry a more significant R&D effort;
- Play a key role in sub-supplier management (as first tier suppliers).

The advantages of this specific structural feature are discussed later in the sections dealing with competitiveness and strategies for its improvement, where the connection between structural and competitive factors is also highlighted.

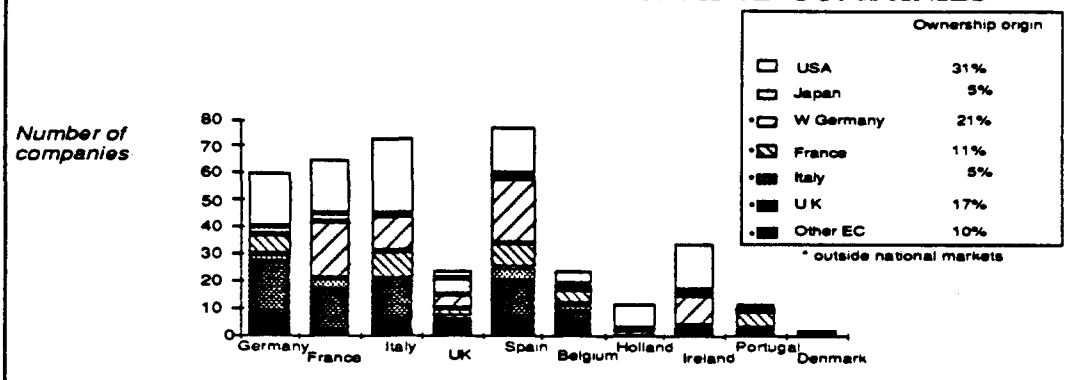
A tendency towards increased outsourcing from a reduced number of suppliers in Europe is likely and will tend to increase the degree of concentration of the component industry. OEM strategies to reduce the number of suppliers will imply fewer direct supply opportunities encouraging concentration. Design delegation will mean a heavier R&D burden for component suppliers which requires critical mass/economies of scale at the component producer level. Increased systems purchasing will require the mastery of a broader number of technologies and will lead to major suppliers building 'systems' portfolios. As argued later, the technology content of componentry is likely to increase which implies higher R&D intensity to compete in a mature market. Fledgling Europe wide purchasing policies of OEMs may require multicountry presence and favour increased concentration in a number of component areas.

The greater level of concentration of component suppliers with direct contacts with the vehicle manufacturers does not necessarily imply a radical reduction in the number of independent component producers. Many will survive as second or third tier suppliers to the component companies producing complete systems or subsystems.

Ownership and foreign investment

The study furthermore investigated the structure of component company ownership in the EC using a representative sample. 35% of enterprises in of our sample were foreign-owned:

FOREIGN OWNERSHIP OF SAMPLE COMPANIES



	Germany	France	Italy	UK	Spain	Belgium	Holland	Ireland	Portugal	Denmark
Sample size	300	143	200	151	169	70	43	56	26	10
Domestic-owned	236	78	127	107	92	46	31	22	14	8
Sample as % of total employees	90	72	84	82	44	78	74	100	72	83

Source: Trade Associations, PRS Analysis

The table shows - based on our sample - that West German companies are the main investors in the EC outside their domestic markets among EC countries. There is a high proportion of German-owned companies in Spain explained by the fact that component manufacturers followed VW, GM, and Ford there to supply them and take advantage of lower labour costs and investment incentives. The US is the key extra-European country which has established or acquired companies in the EC

The likely pattern and significance of *Japanese autocomponent investment in the EC* were explored in discussions with Japanese and EC component and vehicle manufacturers. The pattern of investment in the USA and the likelihood of its repetition were also examined.

Japanese component producers rapidly followed Japanese vehicle manufacturers in establishing manufacturing bases in the US; by 1989 more than 800 companies had done so. A variety of factors drove this wave of US investment. The appreciation of the yen against the dollar made both car and component exports to the US increasingly unattractive. Japanese component manufacturers faced a potential stagnation of demand with car exports substituted by US transplant production, as vehicle manufacturers bowed to pressure to moderate exports and localise production. Japanese vehicle producers actively encouraged Japanese component producers to invest in the US. Given the high levels of vertical integration of US car producers much componentry was unobtainable from the independent sector. Local availability problems were particularly acute for small car components and were exacerbated by poor quality and cost performance relative to Japanese producers. Aftermarket opportunities resulting from the large Japanese vehicle parc in the US and established distribution channels were also a factor encouraging investment in the US by Japanese component producers.

Many of the factors mentioned above might also apply to the EC. Trade friction has given rise to Japanese car export stagnation through national quotas and "voluntary export restraints". Fears of "Fortress Europe" post-1992 have fuelled the establishment of Japanese transplants within the EC.

However, in many key respects the *investment environments in the EC and US differ markedly for Japanese component producers*. The indigenous European independent

component industry is larger than that of the US due to a lower level of vehicle producer vertical integration and arguably more competitive along a number of dimensions as will be discussed later.

Politically, trade friction has been supplemented by a growing sensitivity to "investment friction" and Japanese vehicle companies perceive pressure to source from established local suppliers. The EC is also perceived as being a higher risk, more complex investment environment than the US due to linguistic, cultural and market diversity, and substantial EC policy uncertainty relating to Japanese imports, transplant production, local content and competition in car distribution (block exemption).

Currently many Japanese component companies are preoccupied with their US investments given limited investment and management resources. Moreover, the Japanese domestic business climate has changed somewhat since 1985 and fears of "kudoka" or the hollowing out of the Japanese economy have receded due to economic restructuring measures promoting "naijukakudai" or domestic led growth. Vehicle and component producers successfully rationalised to reduce breakeven points following the steep appreciation of the yen. These factors have tended to decrease the sense of urgency towards overseas investment.

The extent of EC investment by Japanese autocomponent companies will therefore probably be markedly less than in the US and the pattern of investment will differ. There will be less greenfield investment due to fewer gaps in the EC component industry and highlighted sensitivity to investment friction issues. There will be fewer "linked" investments between Japanese car and component companies. There will be more technology transfers, joint ventures and acquisitions of established companies. Approximately half of Japanese component investments in the EC so far have been joint ventures, compared to only approximately 20% in the US.

The differences in investment environments between EC and US are illustrated by the following typical statements by *Japanese component producers*...

" ...EC is more difficult ...legal, cultural and linguistic diversity and lower availability of business information. Risk is higher...trade and local content policies are still uncertain"

" ...Japanese vehicle producers are tending to source from local producers"

"...MITI are promoting joint ventures and technical collaborations rather than wholly owned greenfield investments"

" joint ventures with local suppliers are preferred because volumes are too small, Nissan has a strict localisation policy and because we wanted to sell to European vehicle producers".

...and *Japanese vehicle manufacturers*:

"We have a vigorous localisation policy and adopt a somewhat negative stance towards Japanese supplier investment...technical collaborations and joint ventures are encouraged when difficulties occur with local suppliers however"

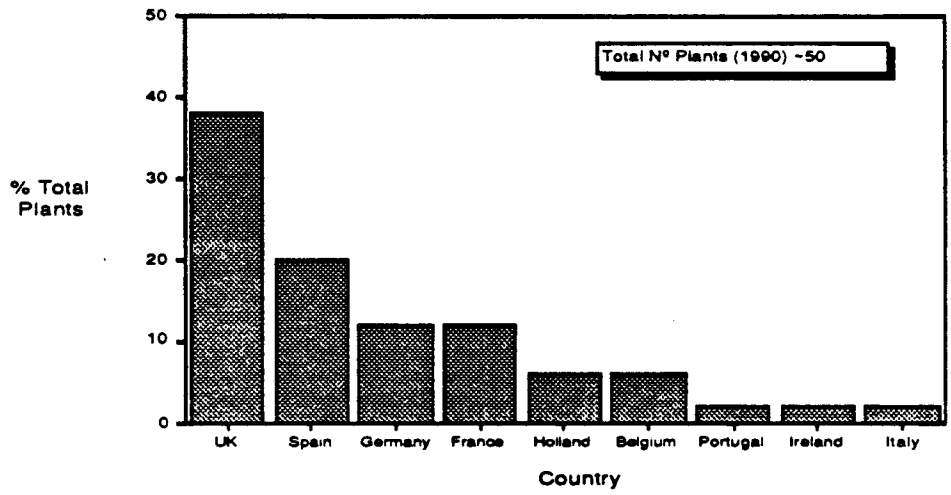
"Locally owned suppliers are preferred to Japanese joint ventures, which are preferred to 100% Japanese investments".

The figure below shows the pattern of EC investment by Japanese autocomponent producers so far. 40% of the fifty or so investments so far relate to the UK. Japanese component producers interviewed explained their preference for the UK by the following factors:

- concentration of transplant production by Nissan, Toyota, and Honda in UK
- low labour costs
- English language
- stable labour relations in recent years
- positive central and local government attitudes.

The EC investment activity of Japanese component companies represents not only a threat but also a significant opportunity for EC producers to improve competitiveness by entering into joint ventures and adopting best practice in relation to quality management, manufacturing process, logistics and new product development (as will be described later).

THE UK IS THE PREFERRED INVESTMENT LOCATION FOR JAPANESE AUTOCOMPONENT COMPANIES WITHIN THE EC

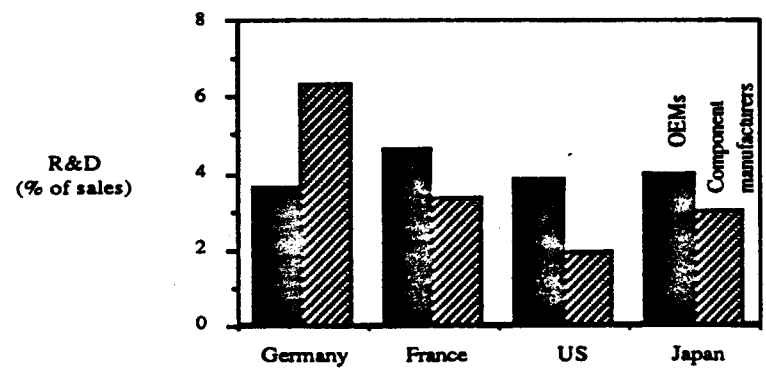


Source: Japia, Toyo Keizai, LTCB, Press, BCG Analysis

TECHNOLOGY AND R&D

The European automotive industry has a relatively strong position in advanced automotive product technology, which is reflected in its relatively high Research and Development (R&D) expenditure both compared to the US and Japan:

R&D EXPENDITURE IN THE AUTOMOTIVE INDUSTRY



Source: BCG Analysis

As a weighted average proportion of sales, total industry spending on R&D in the European Community (including not only Germany and France, but also the other key countries such as the UK, Italy, and Spain) is around 4%, compared to 3.5% in Japan and a slightly lower figure in the US. These estimates include spending throughout the value chain - at both the vehicle producers and the independent component producers. The level and relative importance of the R&D expenditure by component companies in the EC is greater than that in the US and to, a lesser extent, in Japan. However, as will be explained later, the European industry is less effective at translating strong basic product technology into rapid new model introductions, because of structural problems in the new product development process between OEMs and component suppliers.

Car manufacturers are trying to enhance product appeal and status by incorporating 'high-tech' component systems. This trend can be enforced through legislation (eg catalysts), demanded by market forces/consumers (eg ASR/ABS) or driven by competitive pressures. "High-tech" innovations will have a significant impact on the European supplier base. New entrants are emerging as diverse technologies from outside the core automotive supply structure are adapted for use in automotive applications (eg electronic communications, multiplexing). The number of suppliers available to vehicle manufacturers is limited by the high investment requirement in new technology and consequent barriers to entry. New technology based systems may result in established automotive suppliers being forced out of the industry as products fail to match the needs of future car models.

Electronics will become an integral part to most mechanical systems within a vehicle by the end of the decade, and will also add totally new systems:

- Almost all new petrol engines will have **electronic fuel systems. Emissions control** legislation means that 98% of cars will have fuel injection by 1995 and the use of engine management systems (EMS) will increase rapidly.

- **Anti-lock braking (ABS)** is one of the fastest growing examples of all electronic/mechanical system with 40% fitment expected by 1995.

- **Air conditioning** is part of the drive for greater comfort and is expected to penetrate into small and medium cars. By 2000 80% of air conditioning will have electronic controls.

- **Steering** systems will incorporate Electronic Control Units (ECU) by the mid-1990s.

- **Semi-active suspension** will increase penetration particularly in high-performance models.

- **Instrumentation and displays** will incorporate electronics such as LCD's, head up displays, electronic (doppler effect) speedometers.

- **Driver/road interface** systems may show some use by the end of the 1990's.

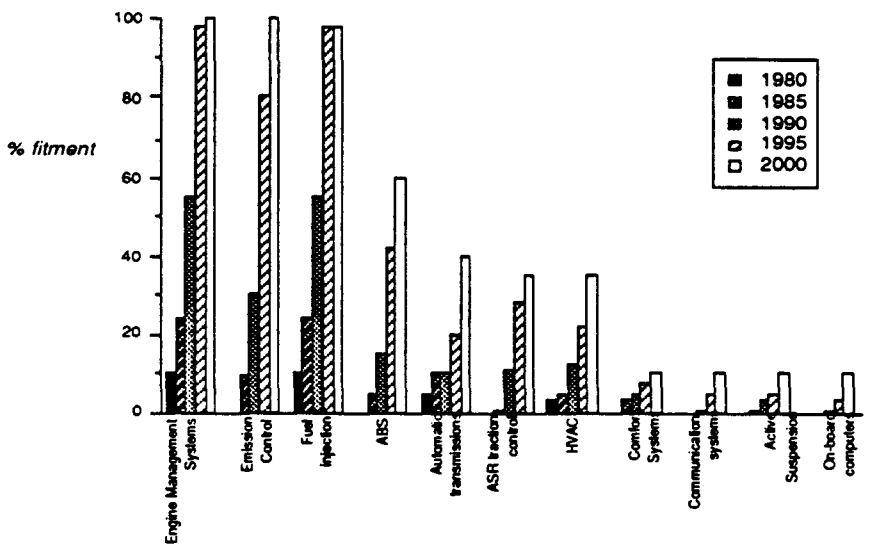
- **Passive restraint systems** such as air bags and intelligent seat belts will increasingly be adopted.

- **Multiplexing** is likely to be adopted in the 1990s as systems protocols are developed and offers many advantages:
  - Systems reliability
  - Reduced harness size
  - Lower installation costs

- Diagnostic capabilities
- Systems integration
- Higher informational capacity
- Greater ease of customisation.

The expected rate of penetration of these new high technology components is shown below.

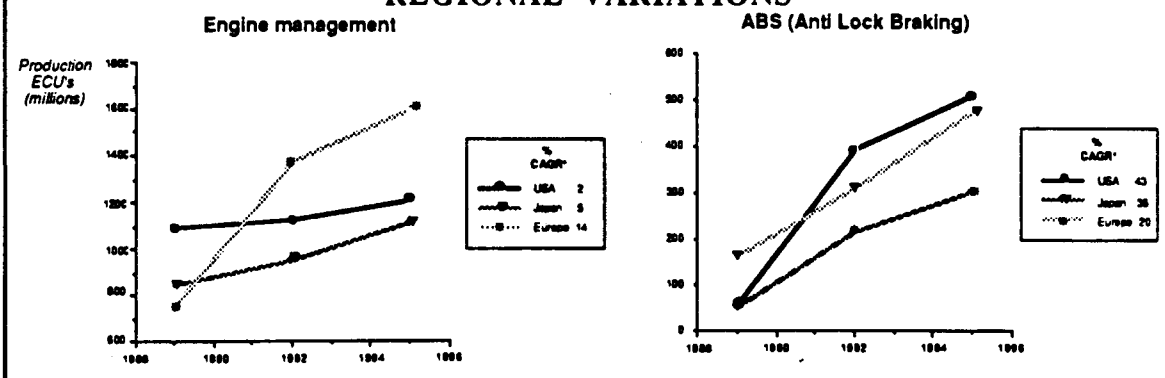
HISTORIC AND FORECAST FITMENT RATES FOR SPECIFIC "HIGH TECH" COMPONENTS IN EUROPE



Source: Automotive Electronics Report, PRS Databases

The following display shows, based on assembler and supplier interviews, anticipated growth rates for selected high tech components. The EC industry is expected to play a key role in this area both because of the importance of leading luxury car producers and the strong existing position of EC companies.

FORECAST ELECTRONIC SYSTEMS PRODUCTION TO SHOW STRONG REGIONAL VARIATIONS



*Compound Annual Growth Rate

Source: PRS Analysis

Environmental issues are a key driver in technological change and legislation can play a role in putting local component producers in an advantageous competitive position, forcing

producers to develop new technologies or to use new materials, as shown by these examples:

- Pressure on vehicles to be **fuel efficient** has led to increased usage of plastics and other light materials to reduce weight and drag coefficient. Possible environmentally related taxes on fuel consumption or CO_2 emissions would accelerate these pressures.

- **Recycling** issues are also causing plastic to be examined more closely. Major OEMs now demand suppliers to put forward a recycling procedure prior to adopting a new plastic part.

- **Recycling** to lower grade products is possible (eg Fiat Tipo tailgate waste goes to make floor tiles).

- **Noise emissions** are being dealt with by adopting polymers to suppress and shield engine noise (encapsulation).

- **Emissions legislation** has resulted in new materials developments for safety at work (styrene emissions, water based paints).

- **CFC-free** foaming agents are now required by auto manufacturers for seating systems. CFC refrigerants in air conditioning systems will be replaced by the mid-1990s.

- Safety of cars has led to **non-toxic materials** being required.

- **Incineration** for energy recovery is also viable (Dow/Voest-Alpine).

- Etc.

Increased technological content of components will, as indicated above, shift the locus of R&D product development and systems assembly increasingly to suppliers and will require a higher degree of skills in product development. Some of the competitive implications of these trends are discussed in later sections.

FINANCIAL PERFORMANCE

European component manufacturers have improved their financial performance since 1984 until the current downturn. However, compared to the US and Japan, the record of European producers has been mixed: European producers have traditionally underperformed on key parameters. The improvements in recent years have now brought profitability up to that of Japanese competitors although it is still behind significantly in the underlying indicators of basic competitiveness - stock turns and labour productivity. Within Europe, no country stands out as performing significantly better on all counts, although France has experienced the most significant overall improvement.

In measuring financial performance, the study pursued two main *objectives*:

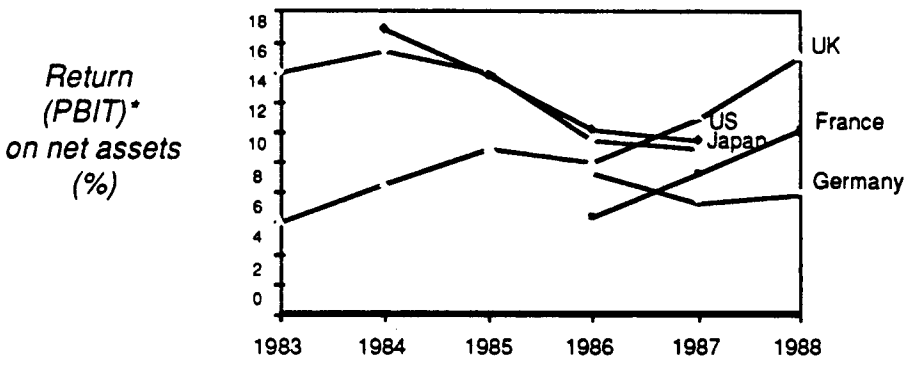
- To understand the current financial position of the European industry and its recent evolution.

- To analyse parameters of financial performance which permit an understanding of the competitiveness of the European industry at an aggregate level.

In order to achieve these objectives, financial comparisons of component and vehicle suppliers were built on the largest possible *sample* of companies. The size of the sample varied across countries (it included 300 companies in France, 120 in the UK, 35 in Germany, 230 in the US and 70 in Japan). Country averages have been calculated by taking the weighted average of individual producer's data. We have relied on several data sources, such as ICC (UK), Jordans and direct information from companies(FRG), Value Line (USA), SESSI and FIEV in France and the Japan Auto Parts Industries Association (JAPIA). The Japanese sample accounts for 64% of total autocomponents production and covers most large companies.

In the period through 1988, component suppliers' profitability in Europe has increased significantly, particularly in the UK and France. This relates both to return on sales and assets. The following exhibit shows the increase in European asset profitability:

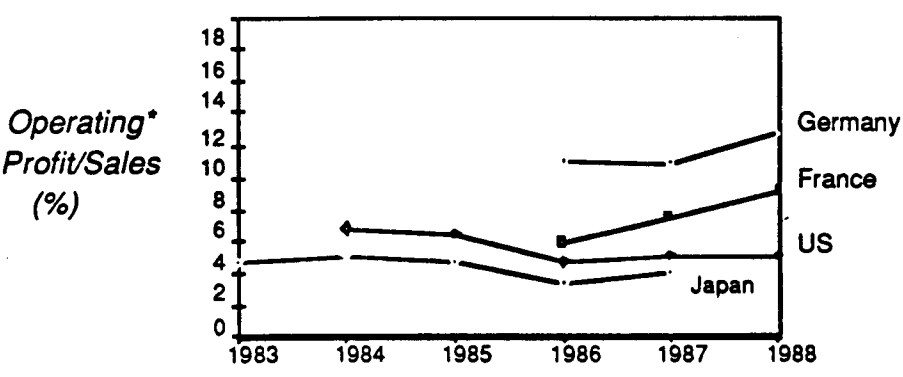
COMPARISON OF AUTOCOMPONENT COMPANIES' PROFITABILITY



*Profit before interest and taxes
Source: ICC, Jordans, FIEV, Value Line, JAPIA

EC profitability has increased in absolute terms and relative to US and Japanese industries. In the above display the successful West German industry appears to have relatively low profitability. The profit figures after extraordinary items and reserve movements for Germany may, however, understate relative profitability for that country. The following graph shows that the underlying operating profitability of the German industry before reserves has been higher than in France, US or Japan:

COMPARISON OF OPERATING PERFORMANCE OF AUTOCOMPONENT COMPANIES

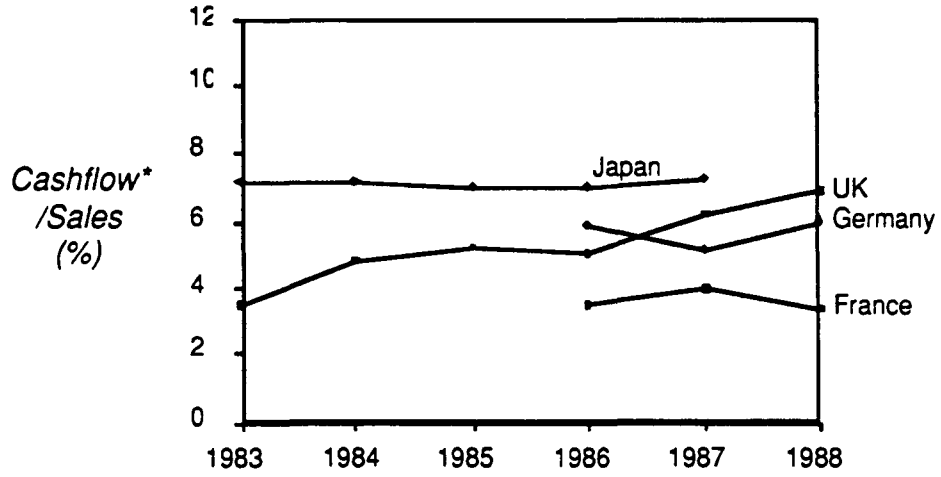


*Excludes reserves and extraordinary items
Source: ICC, Jordans, FIEV, Value Line, Japia

Italy and Spain have been excluded due to insufficiency of publicly available data. However, surveys carried out by vehicle manufacturers in Italy indicate that returns in that country have been relatively high in recent years compared to other European and non European autoparts industries.

In addition to asset and sales profitability, cash flow was analysed in a comparative perspective in order to assess the industries' ability to invest in product development and manufacturing processes. The following chart shows that the Japanese industry has been a stronger cash generator in past years than the European one, indicating strong underlying competitiveness.

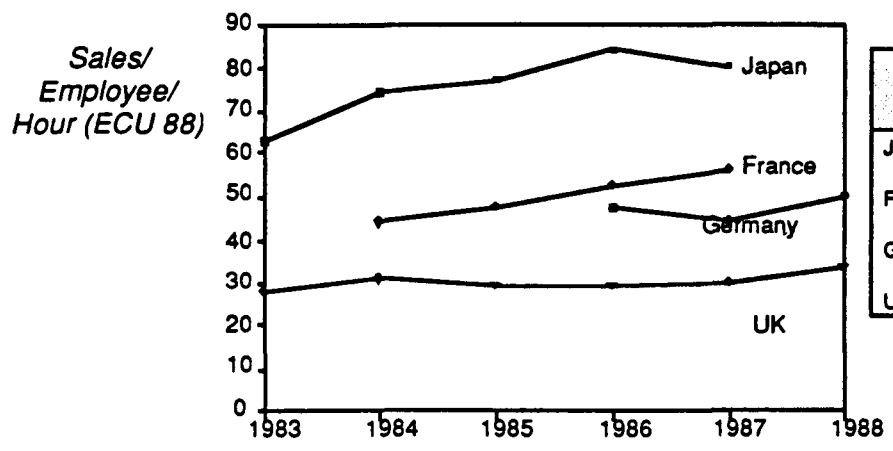
INTERNATIONAL COMPARISON OF CASH FLOW IN THE AUTOCOMPONENTS INDUSTRY



*Cashflow = Profit after taxes + depreciation
Source: Value Line, Japia, ICC, FIEV

Competitiveness was further analysed by looking at key productivity indicators, such as labour productivity and stock turnover. These two measures are correlated and intimately connected to operational competitiveness. Japan shows very high levels of labour productivity:

INTERNATIONAL COMPARISON OF LABOUR PRODUCTIVITY IN THE AUTOCOMPONENTS INDUSTRY



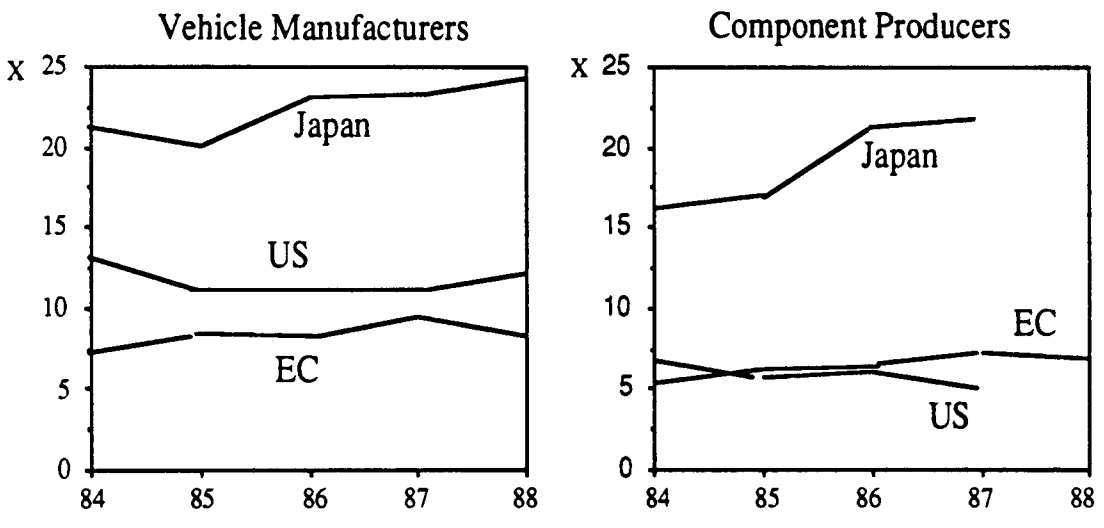
CAGR (%)	
Japan:	6.1
France:	8.5
Germany:	3.6
UK:	3.7

Source: Japia, ICC, Jordans, SESSI.

Japanese labour productivity is between 1.6 and 2.5 times higher than European productivity. If value added per employee is analysed, the gap between Europe and Japan widens even further. Despite relatively high hourly labour costs, Japan has managed to contain labour costs at a constant 20% of sales over the last five years, significantly lower than in Europe. Japan achieved very high rates of productivity growth, averaging 6.1% p.a., whilst growth in Europe was generally lower at 3.6% in the German industry and 3.7% among British companies. French component producers have recently matched or exceeded Japanese growth rates at 8.5% pa.

On another key measure of competitiveness, stock turnover, Japanese component and car companies perform significantly better than European ones. On average, Japanese component producers' stock turnover (Sales/materials, work-in-progress, finished goods stocks) is currently 21x, whilst European levels are roughly one-third that level.

COMPARISONS OF STOCK TURNOVER

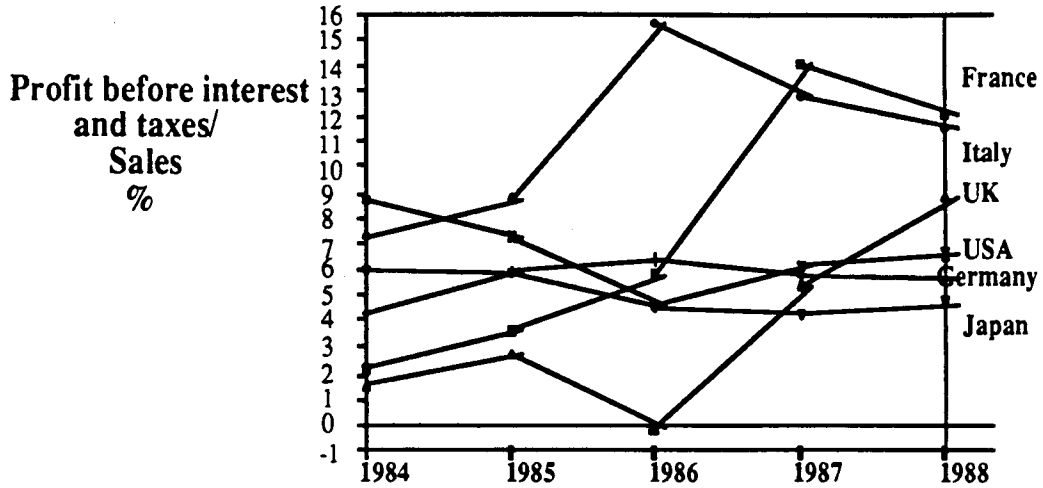


Source: BCG Analysis

This measure is a crucial one, since it reflects adoption of Just-in-Time systems and the degree of sophistication of manufacturing processes and systems of the two industries. As will be pointed out later, significantly higher stock turnover among Japanese companies is the result of a manufacturing approach which implies higher productivity, quality and the ability to deliver products to much shorter lead times. Not only are Japanese companies achieving much higher stock turns than European ones, but they are also improving faster. The above chart also illustrates that superior performance is not limited to the components manufacturers but applies also to the car manufacturers.

The pattern of financial performance of European vehicle manufacturers is very similar to that of component manufacturers. European car and LCV manufacturers have shown high and improving profitability, whilst fundamental indicators of competitiveness remain weak. Profitability grew rapidly during the 1980s to exceed US and Japanese profitability:

INTERNATIONAL COMPARISON OF CAR AND LCV PRODUCER PROFITABILITY

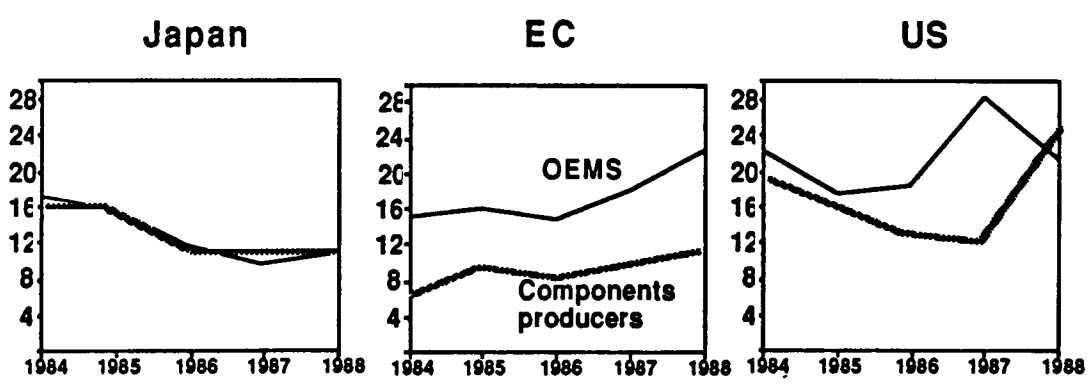


Source: BCG Analysis

However, as in the component industry, the underlying competitiveness of the Japanese car industry is strong. Labour productivity is between 3.5 and 5 times higher than in European countries, whilst stock turnover is 3 times higher than the European average as mentioned earlier.

The comparison of financials of both car manufacturers and component suppliers indicates the relatively low labour productivity and stock utilisation of the European industry - and suggests that higher performance in the Japanese car industry has not been achieved by shifting costs and stocks into other parts of the value chain. In fact, a comparison of profitability between the car manufacturers and their suppliers indicates that in Japan the levels and direction of profits move together, whilst they are dissimilar and diverging in US and Europe :

THE PROFITABILITY OF THE COMPONENT SECTOR IS LOWER THAN THAT OF VEHICLE PRODUCERS IN EUROPE AND THE US
PBIT/net assets %



*Weighted average returns

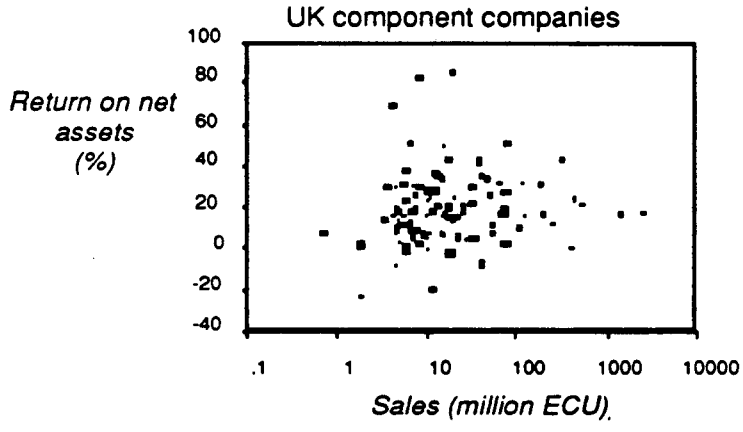
This suggests a high degree of cooperation between component manufacturers and their suppliers in Japan. Improvements in performance are pursued together and gains and reductions in profitability seem to be shared. The philosophy of "unmei kyodotai" ("shared destiny") is reflected in the concrete sharing of operating and financial gains in Japan.

In contrast, in Europe and the US vehicle producers are consistently more profitable than component suppliers. This may reflect the relative bargaining strength of the OEMs relative to a fragmented supplier base and purchasing strategies aimed to a large extent at obtaining low prices.

Overall there is no significant difference over time between total industry profitability levels in Europe and Japan. The decrease in profitability in 1986-88 in Japan reflected strengthening of the Yen; profitability is known to have recovered in 1989-90 to similar levels to those in the EC. This implies that the Japanese industry was passing on its gains in competitiveness (in terms of labour productivity and stock turns) in competitive pricing and investments in expansion abroad.

The study also analysed financial performance of auto components companies as a function of size and product area focus. The following diagram suggests that there is no relationship, among UK producers of automotive components, between company size and profitability:

THERE IS NO APPARENT RELATIONSHIP BETWEEN PROFITABILITY AND COMPANY SCALE



Source: ICC, BCG Analysis

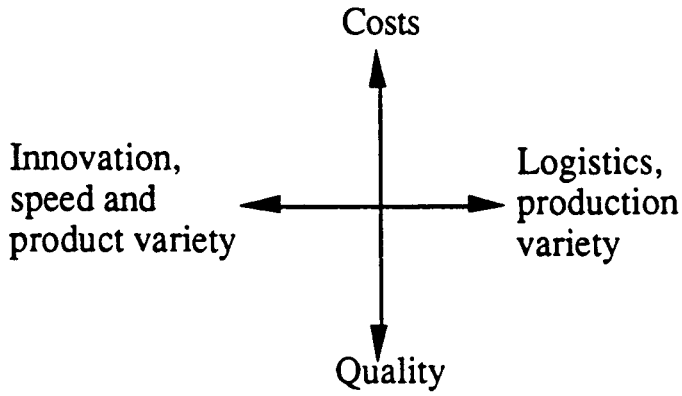
The industry shows a significant degree of of fragmentation; it is one where companies compete on many different variables across the different product groups. Smaller companies can achieve very high levels of profitability whilst larger companies tend to converge around industry average levels of profitability.

Different product segments show significantly different levels of profitability and performance. In the case of the UK, return on net assets ranges from 5% (for internal engine components) to 30% for engine cooling components. Within each product group, financial performance also varies widely across producers. Return on net assets ranges from -25% to more than 40% in most categories.

DIAGNOSIS OF COMPETITIVENESS

The analysis of financial performance indicated the relative weakness on key competitive indicators of the European industry compared to Japan. It is important to understand what underlies the large differences observed in labour productivity and stock turnover.

Competitiveness in the automotive components industry is based on four major factors which are interdependent:



These four basic dimensions are connected to two essential underlying elements:

- Flexible, reliable manufacturing processes, and
- Effective design and development processes.

Flexible and reliable manufacturing processes have a direct impact on product costs, quality, asset productivity and the ability to handle variety in the manufacturing process without cost penalties. They also reduce the need for high overheads to control the manufacturing system. Effective design and development processes permit faster model introductions and variety through lower design cycle times, and imply the ability to reduce engineering overhead. Faster development cycles also mean the capability to redesign and reduce further the costs of products.

In order to understand the factors determining significant cost and productivity differences between European and Japanese producers, BCG analysed performance of European, US and Japanese autocomponent producers at the detailed plant level for a range of different types of components. The analysis included costs, quality, innovation and competitiveness in logistics.

COST COMPETITIVENESS

Japanese plants have, across a great number of product groups, a significant cost advantage compared to European and US factories. The table below shows the detailed analysis of competitiveness in forged automotive components (BCG compared normalised average total cost for 5 types of automotive forgings across 14 companies). The diagram shows that Japanese costs were on average 20% lower than their European and US competitors'. When costs were analysed in detail, the analysis showed that *overhead labour* was a large proportion of total cost and the largest component of any Japanese cost advantage:

COST COMPARISONS FOR AUTOMOTIVE FORGINGS

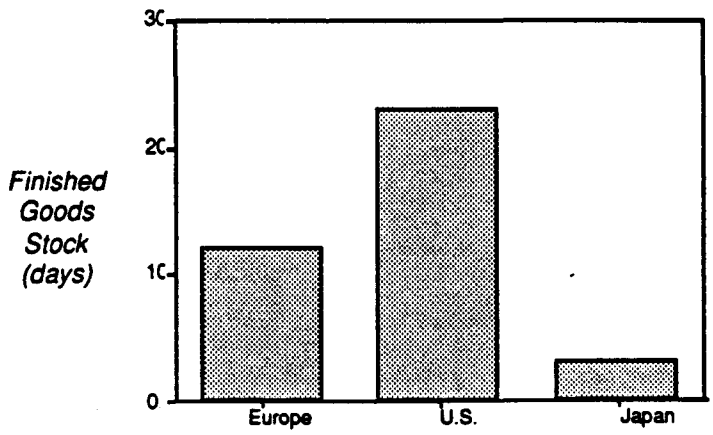
Component	Comparison	Japanese cost advantage (%)	Proportion of cost advantage due to lower overhead labour (%)
Tubular stabilizer	Japan v US	33	44
Solid stabilizer	Japan v US Japan v EC	28 26	65 39
Connecting rod	Japan v US Japan v EC Japan v EC	22 8 20	80 65 36
Spindle	Japan v US Japan v EC	28 11	45 28

Source : BCG

In the case of forged components, analysis showed that Japanese direct labour productivity was twice as high as in European plants, whilst indirect labour or overhead productivity was two and a half times higher. BCG investigated factors potentially explaining such productivity differences, such as product complexity and scale. Analysis showed that the cost advantage enjoyed by Japan was not due to these factors. Nor was it due to higher capital intensity of Japanese plants. Factors which affected labour and stock productivity most were machine utilisation and uptime, faster production cycles and lower scrap and rework rates.

BCG also analysed other product groups, such as car seats, where Japanese manufacturers enjoyed a 10% total cost advantage, mostly due to higher indirect labour productivity and significantly lower stock levels:

JAPANESE SEAT SUPPLIERS HAVE LOWER STOCK LEVELS THAN US AND EUROPEAN SUPPLIERS



* Average stock levels of finished seats, covers and fabric for 11 companies

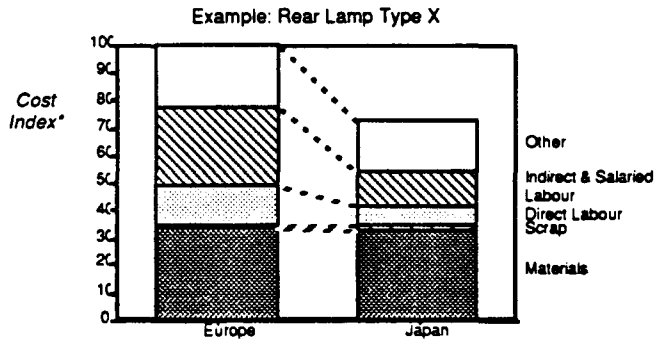
Source : BCG

Superior Japanese performance in this product category was due mainly to the following aspects:

- JIT seat systems supply from dedicated, co-located plants;
- Optimised plant layout for materials flow;
- Multimachine manning to maximise machine utilisation and flexibility;
- Stable, long-term relationship with supplier, with long history of mutual efforts at cost reduction;
- Multi-skilled workforce and team working, leading to lower overheads;
- Etc.

Japanese automotive lighting manufacturers also appear to have a significant cost advantage over US and EC suppliers. Again, the cost advantage in Japanese plants was mainly due to higher indirect labour productivity (on average a factor of 4 times higher) and direct labour productivity (twice as high in Japan than in Europe). This resulted in an overall cost advantage of about 30 percent (the following graph displays an overall cost structure comparison):

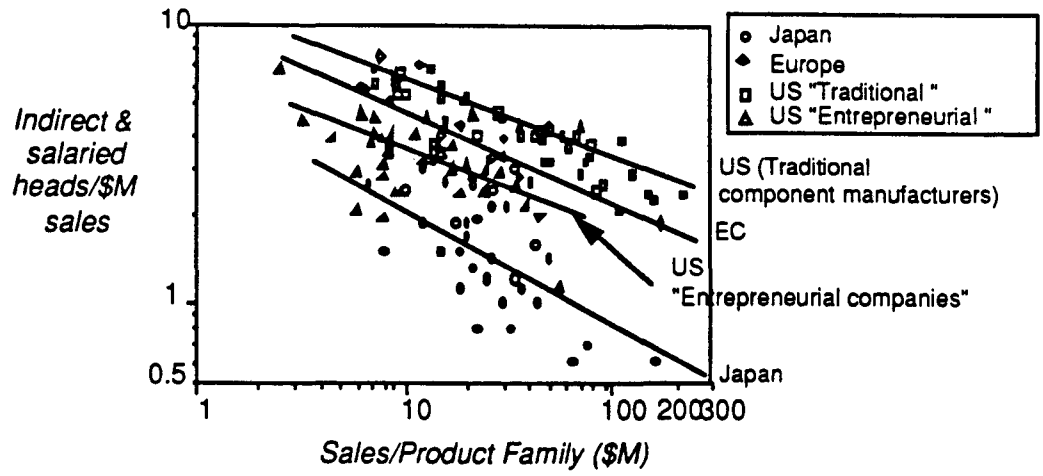
OVERHEAD LABOUR CONSTITUTES THE LARGEST COMPONENT OF JAPANESE COST ADVANTAGE IN AUTOMOTIVE LIGHTING



* Nomalised average relative total cost for 6 companies
Source: BCG Plant Visits & Analysis

The detailed analysis of competitiveness of a variety of different automotive component products confirmed the relative weakness of European manufacturers shown by the overall industry financials. Common to all the product groups analysed was the relatively low labour productivity and related cost disadvantage which was mainly due to low productivity of indirect labour and overheads, independent of plant size and volumes per product family as shown below:

JAPANESE PLANTS HAVE HIGHER INDIRECT LABOUR PRODUCTIVITY THAN US AND EUROPEAN PLANTS ACROSS A WIDE RANGE OF AUTOCOMPONENT TYPES

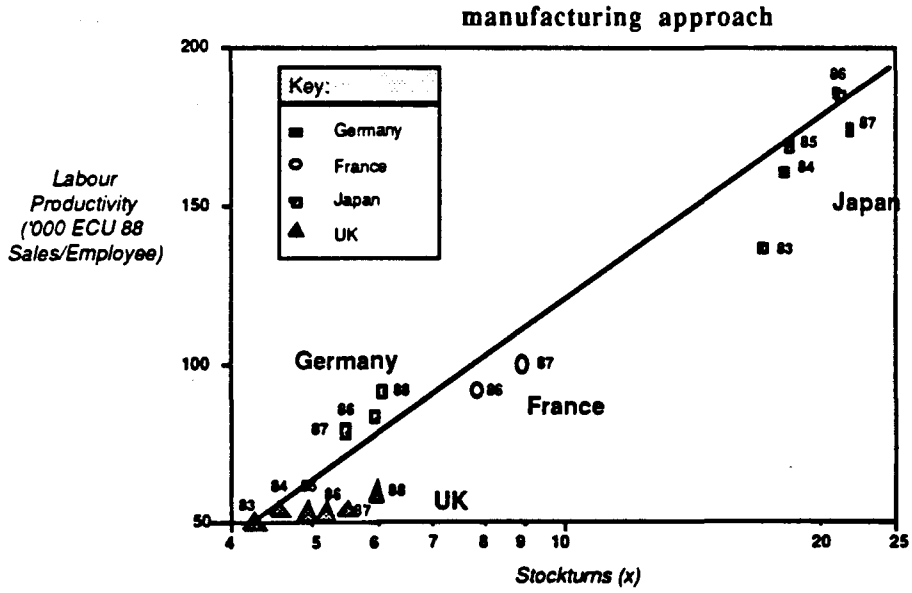


Note: Sample of automotive component plants across a broad range of products
Source: BCG

Labour productivity and stock turnover are closely related and are both driven by and indicators of the overall manufacturing approach. The exhibit below indicates how the two variables tend to improve simultaneously from one year to the next at the aggregate national level:

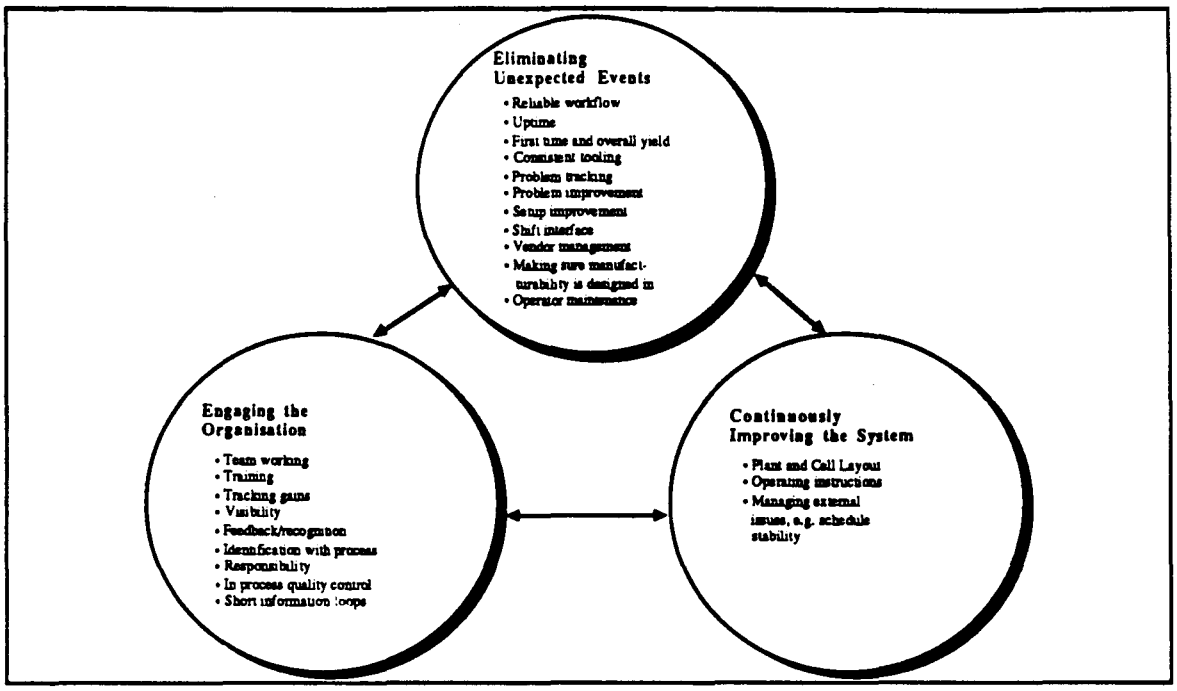
EUROPEAN AUTOCOMPONENT PRODUCERS HAVE RELATIVELY LOW EMPLOYEE AND STOCK PRODUCTIVITIES RELATIVE TO THE JAPANESE

- **The two factors are connected and relate to differences in manufacturing approach**



Source: Japia, ICC, Jordans, FIEV, Value Line, BCG Analysis

The European autocomponents industry, especially in France and Germany, has been improving steadily along both dimensions, but the competitive gap remains as the Japanese continue to sustain rapid progress. Japanese cost and productivity advantages can be attributed to the manufacturing approach. This manufacturing approach is characterised by the following three main aspects: elimination of unexpected events, continuous improvement of the system and full engagement of the organisation.



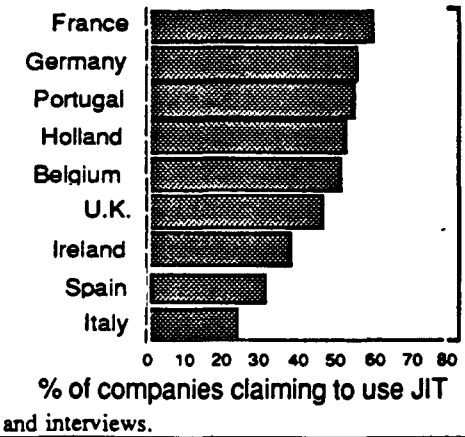
JUST-IN-TIME

The Japanese auto industry derives considerable benefits from the widespread adoption of Just-in-Time logistics based on synchronised production and delivery between suppliers and customers. Synchronised production can lead to:

- Lower inventory levels and costs
- Lower costs due to less requirements for space and indirect costs related to materials handling, scheduling, etc
- Reduced lead times
- Greater flexibility and responsiveness to demand
- Lower scheduling overheads
- Improved problem visibility and hence resolution, leading to improved quality
- Improved supply chain coordination
- Removal of phase lags in stock and production cycles.

A very large proportion of EC autocomponents companies *claim* to be using JIT logistics as is illustrated by the following display based on a survey of over 400 companies carried out during this study:

OVER 40% OF EC AUTOCOMPONENT COMPANIES CLAIM TO BE USING JIT



Source: PRS/BCG Questionnaire and interviews.

However, stock turns are a key indicator of the effective adoption of the JIT approach and Japan outperforms Europe on this dimension at both levels of the chain:

Country	Vehicle Assembler	Component Suppliers
Japan	24.2 x	21.5 x
UK	5.2 x	5.5 x
France	11.2 x	8.9 x
Germany	11.2 x	7.0 x
US	12.0 x	4.9 x

It was also pointed out previously that the gap between Japan and EC countries is increasing, given in the very fast rates of inventory turnover improvement in Japan. The evidence on stock turns contradicts the apparent adoption of JIT revealed in the survey.

When analysed in detail, however, the majority of supply relationships described as JIT are extremely limited in scope, and are frequently based on the creation of buffer stocks close to the assembly plant. Such arrangements prompt an understandably pessimistic attitude by suppliers: "JIT means assemblers requiring us to maintain 5-10 days safety stock at our own expense .. JIT is an unwelcome attempt to force us to take on local storage facilities" are typical supplier comments. There are, however, an extremely limited number of successful JIT relationships (in the true sense of synchronous manufacture) to be found in Europe. In the table below, we list all the examples identified during the study:

Country	OEM	Supplier	Component
Germany	BMW	Schmidt	Seats
		-	Carpets
		-	Bumpers
	Daimler Benz	Keiper Recaro	Seats
	Audi	Schmidt	Seats
France	Renault	Epeda Bertrand Faure	Seats
		-	Bumpers
	Citroen	Epeda Bertrand Faure	Seats
UK	Nissan	Ikeda Hoover	Seats, Interior trim
		Nissan Yamato	Structural pressings
		Calsonic	Exhaust silencers
	Rover	TRW Camgears	Suspension modules
Spain	Renault	Epeda Bertrand Faure	Seats
Portugal	Renault	Epeda Bertrand Faure	Seats

There are several obstacles to the implementation of JIT logistics in the EC automotive industry, such as lack of geographic proximity, the predominance of components vs systems sourcing in Europe, a relatively high incidence of labour disputes in some EC countries, the absence of Electronic Data Interchange (EDI) systems and the fragmented structure of the industry.

JIT logistics are generally thought to require a supply distance less than 2 hours or 50 km, whilst EC suppliers are often geographically dispersed. Geographical obstacles are not insurmountable, however, given that there are major areas of concentrated automotive activity within the EC:

- Turin (Italy);
- West Midlands (UK);
- Stuttgart (Germany);
- Paris (France);
- Etc.

Furthermore, JIT is more economically attractive for bulky assemblies like seats than individual components because of high transport and stock holding costs. The simultaneous establishment of JIT for many components is less feasible than the JIT sourcing of fewer component systems. JIT implementation is therefore facilitated by moves towards greater systems outsourcing.

Close cooperation is essential for success since suppliers often need to invest in "doorstep" plants, systems and require dedication of management resources. Successful JIT is based on the optimisation of the whole supply chain from materials procurement for component manufacture through to vehicle assembly, and there is a need to communicate technical and managerial know how between suppliers and car manufacturers. European supplier - OEM relationships have been traditionally based on short term contracts and multiple and competitive sourcing by OEMs with frequent supplier switching. There is a relatively low degree of mutual dependence leading generally to limited mechanisms for cooperation. European car manufacturers typically strive to have competitive supply for parts wherever possible and minimise involvement in suppliers' internal affairs, whilst single OEM dedication is feared by suppliers for the overdependence it implies. In contrast, Japanese OEMs coordinate campaigns aimed at improving efficiency and productivity throughout the entire value chain.

Several steps can be taken to facilitate the improvement of logistical competitiveness. These include the reform of adversarial attitudes through the promotion of long term contracts, and single sourcing. Producers must address whole value chain competitiveness and aim at synchronised manufacture between suppliers and assemblers rather than just frequent delivery, which has often resulted in only extra buffer stocks. There is a need to *reconfigure* the supply structure increasingly through:

- Systems outsourcing,
- Doorstep sub-assembly plants, and
- Fewer direct suppliers.

At the same time it is necessary to establish channels for technical/managerial collaboration through supplier associations and staff exchanges. Just-in-time know how needs to be assimilated based on successful EC and Japanese examples and joint ventures with Japanese suppliers. The increased harmonisation of EDI protocols can further contribute to the adoption of JIT systems.

COMPONENTS QUALITY

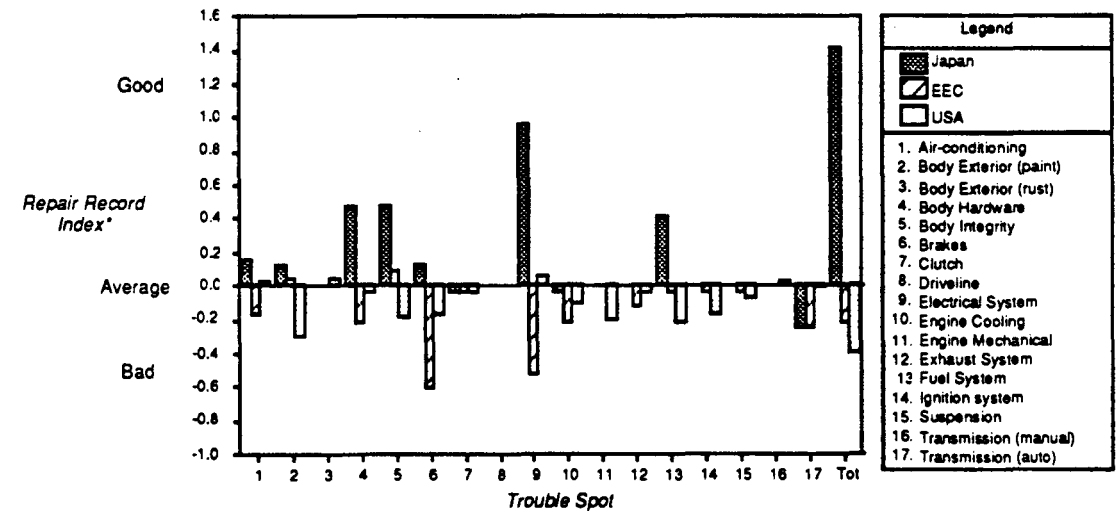
The analysis of components quality focused on the more quantifiable aspects of quality. The study analysed component reliability based on the observation of breakdowns, cost of maintenance and repairs and average life. It measured quality of Japanese, EC and US component manufacturers. This was done at different levels: firstly we compared overall

car quality (% breakdowns over a year, cost of on-going maintenance and repairs). This analysis was based on a sample of 86 car models and 21 makes sold on the European market. Furthermore individual component quality was analysed based on repair record by component type (based on a sample of 306 models sold on the US market). This comparative analysis was performed for 17 "trouble spots". BCG also analysed the average life of selected components.

The analysis of overall car breakdowns showed that Japanese cars suffer fewer breakdowns than even the best European competition, on average, only 2.8% of Japanese cars in the European market suffered breakdowns in a given year, compared to 4.8% of German cars, 5.6% of UK manufacturers' cars, 6% of Ford's and GM's European production, 7.2% of French cars and 10.2% of Italian cars.

The superior breakdown performance of Japanese cars compared to European cars was corroborated by the analysis of the repair record by individual trouble spots. The following diagram shows the relative repair record of Japanese, EC and US cars by functional component family. The analysis indicates that Japanese components have a significantly superior repair record than their EC and US competitors in most product groups:

COMPARISON OF REPAIR RECORD BY PRODUCT GROUP

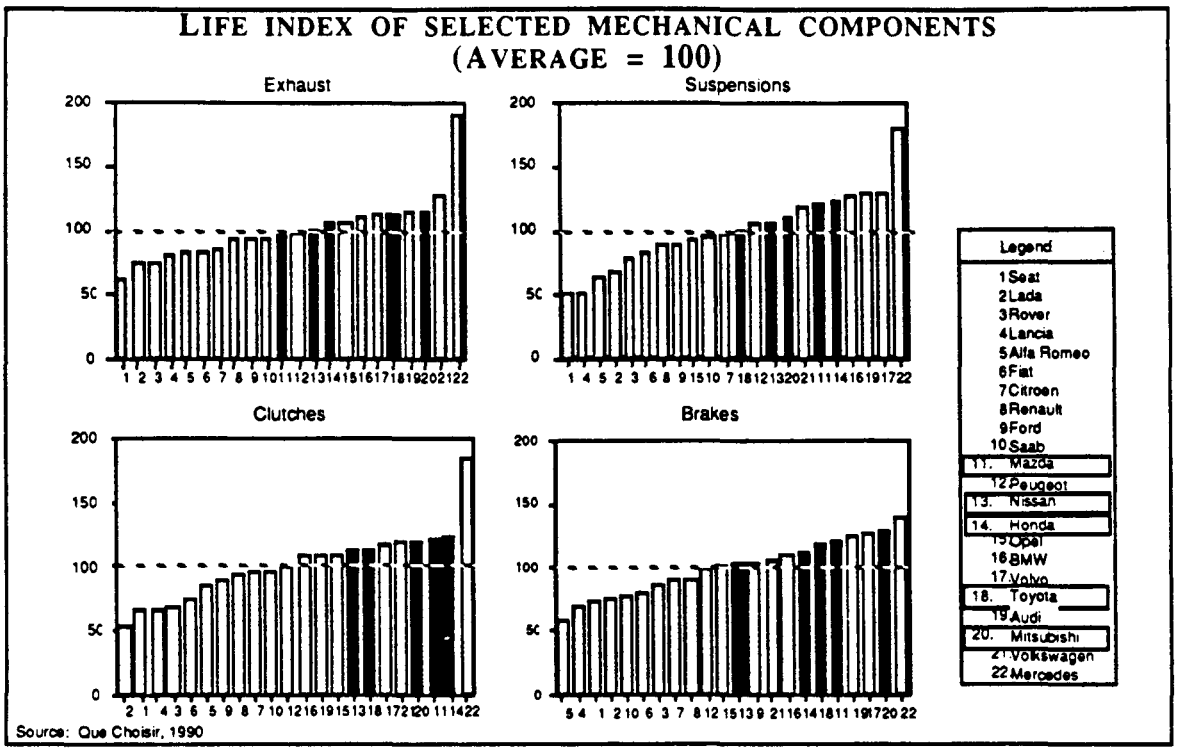


* Index measures car performance based on the frequency of repair of 17 trouble spots. Index ranges from +2 (much better than average) to -2 (much worse than average)

Source: US Consumer Reports, March 1990

Relatively low performance does not imply failure only at the component level, since trouble spots can reflect either component integrity, system problems or poor assembly . The above analysis is based on a US sample which includes a high proportion of high value European competitors. One can assume that the differences between Japanese and EC components would be wider if a broader sample of European cars were to be taken.

The picture of lower breakdown performance per trouble spot is confirmed by the analysis of individual component life expectancy in the European market:



On average the Japanese industry has the highest country performance, but individual European manufacturers, notably Mercedes Benz, still achieve the highest quality/durability ratings.

The majority of European vehicle manufacturers have acknowledged the performance gap and are beginning to implement programs to improve quality. Fiat for example believes that quality is affected by the structure and nature of supplier relationships and is reducing the number of suppliers and entering longer term contracts: currently each component is supplied by 2-3 firms under annual contracts. The goal is now to outsource 80% of component requirement to one supplier for up to 5 years. According to Fiat this scheme "should allow the component manufacturer to improve its quality, and Fiat to improve the system by working in greater cooperation with its (fewer) suppliers" . Volkswagen is following a very similar approach: "If we want to improve the quality of our product, we will have to change the number of products supplied by any single supplier and go selectively to longer term relationships". Ford has introduced a supplier certification scheme which is mainly focused on product quality and uses fully documented absolute quality standards (Q101). A growing proportion of suppliers are achieving this absolute standard and Ford pursues the objective to source from certified suppliers only. The Q101 standard may be supplemented in the future by a wider scheme, encompassing delivery, management quality, design capability, etc.

Although the schemes followed by European vehicle manufacturers are likely to yield significant improvements, they seem insufficient by themselves to generate forms of cooperation between suppliers and vehicle manufacturers which will in the future *assure* that continuous improvements in quality are pursued by the whole automotive value chain. Japanese observers of the European automotive scene comment that the approach taken by European vehicle manufacturers to improve their quality is perhaps still excessively contractual instead of being based on a philosophy of close cooperation: "The European approach is heavily documentation based, more precise than any Japanese equivalent; a reflection of a legalistic - contractual mentality. Japanese systems are more vague, evolutionary, and emphasize a problem solving approach... Japanese suppliers achieve

actual tolerances 3 or 4 times finer than those stated on engineering drawings. Suppliers are committed to meeting unspecified future requirements as appropriate."

Data over the last 10 years from the UK market show that the average quality of cars in operation is steadily improving; the number of faults and problems experienced has declined at a rate of approximately 5% pa over the period. Clearly, continuous improvements in quality of this order of magnitude will be needed by producers just to maintain current relative position; higher rates will be needed to close the present gap with Japan.

COMPETITIVENESS IN INNOVATION

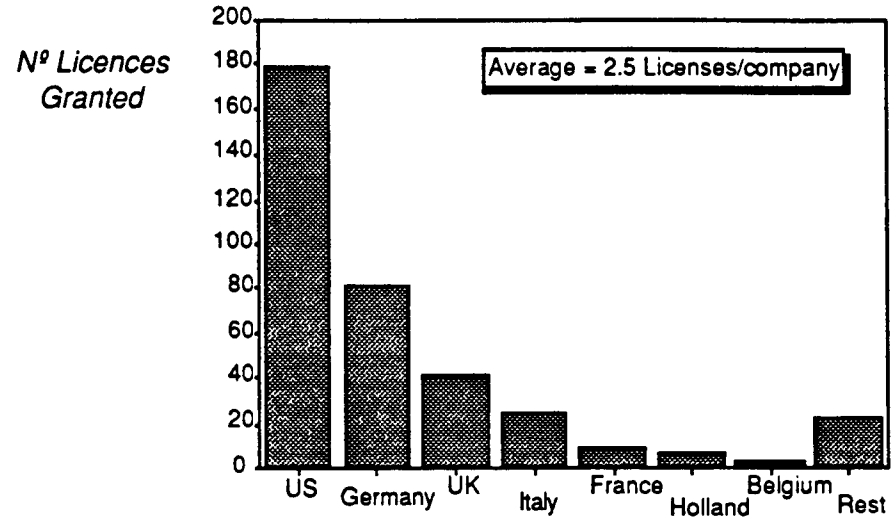
Technology and the ability to manage the product development process are the key elements of competitiveness in innovation. The EC industry has a number of areas of technological strength, such as ABS and EFI. These strengths are based upon a number of underlying factors, such as a strong engineering industry. The EC industry also benefits from the presence of specialist, high value vehicle manufacturers and the existence of large independent component manufacturers with significant R&D capability. However, competitiveness in vehicles and components is also dependent upon product development capabilities such as fast development cycles, the ability to sustain high variety and the effective management of development processes between vehicle manufacturers and suppliers. Vehicle market maturity mean that developmental capabilities are increasingly important in order to respond rapidly to the requirements of an increasing number of consumer segments.

Technology:

In a comparative perspective the EC, the US and Japan all have areas of technological advantage in automotive components. The EC has a strong technological position in products such as continuously variable transmissions, antilock brakes, electronic fuel injection, automotive electronics, constant velocity joints, water-based paints, etc. On the other hand, Japan is thought to have a technological advantage in products such as turbochargers, multivalve engines, ceramics, four wheel steering, memory seats, etc. It appears that in terms of basic product technology neither Japan nor the EC has clear overall superiority.

European strength is reflected in the European licensing record to Japan. EC component producers have granted as many licenses as the US, which has long ties with the Japanese industry, especially through shareholding such as GM/Isuzu, Ford/Mazda. The following exhibit shows currently active technology licences to the major Japanese autocomponents producers by country of origin. European manufactures are key technology providers to Japan with Germany, the UK, and Italy playing the key roles:

CURRENT TECHNOLOGY LICENCES TO 142 MAJOR JAPANESE AUTOCOMPONENT PRODUCERS



Source: JAPIA, BCG Analysis

COMPETITIVENESS IN PRODUCT DEVELOPMENT:

Undoubtedly, European producers have a strong position as far as key technological innovations are concerned and Europe is a key provider of such technology world-wide both through licences and export activities. However, competitiveness in product innovation is more and more based not on achieving technological breakthroughs, but on the ability to provide model specific features and the ability to compress the development cycles for new products. Such competitiveness depends on continual improvements in product development cost and reduced development lead times. Successful product developers emphasise manufacturability and product quality.

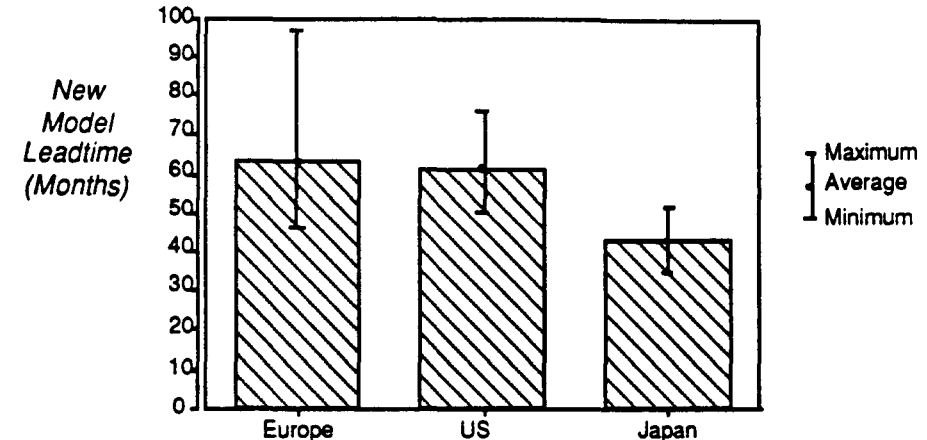
Faster and more productive development processes yield significant competitive advantages, since they imply the ability to respond rapidly to emerging market needs, eg based on environmental protection, safety requirements and consumer taste trends. Fast developers can reap the advantages of first entry, can exploit market niches (4x4 utility vehicles, 2 seater sports cars, for example), can 'experiment' in the market place rapidly introducing models or variants and adjusting, modifying, enhancing and withdrawing models according to market response. Rapid new product introductions can create sustainable differentiation in a mature market and enhance price realisation and market share.

Moreover, increased variety and shorter product development cycles imply reduced downside risks for new model failures, given a smaller investment per new model the spreading of risk over a wider portfolio, and a lesser risk of being outdated by changing consumer needs or preemptive introductions of similar products by competitors.

For all these reasons, we are of the firm belief that *rapid new product development will be one of the most important competitive weapons in the automotive industry in the 1990s.* It will be critical for European automotive producers together with their component suppliers to significantly improve their performance along this critical dimension of competition.

Today model development cycles are typically significantly longer for European and US manufacturers than for Japanese ones:

JAPANESE VEHICLE MANUFACTURERS HAVE MUCH SHORTER PRODUCT DEVELOPMENT TIMES THAN THOSE IN EUROPE OR THE US

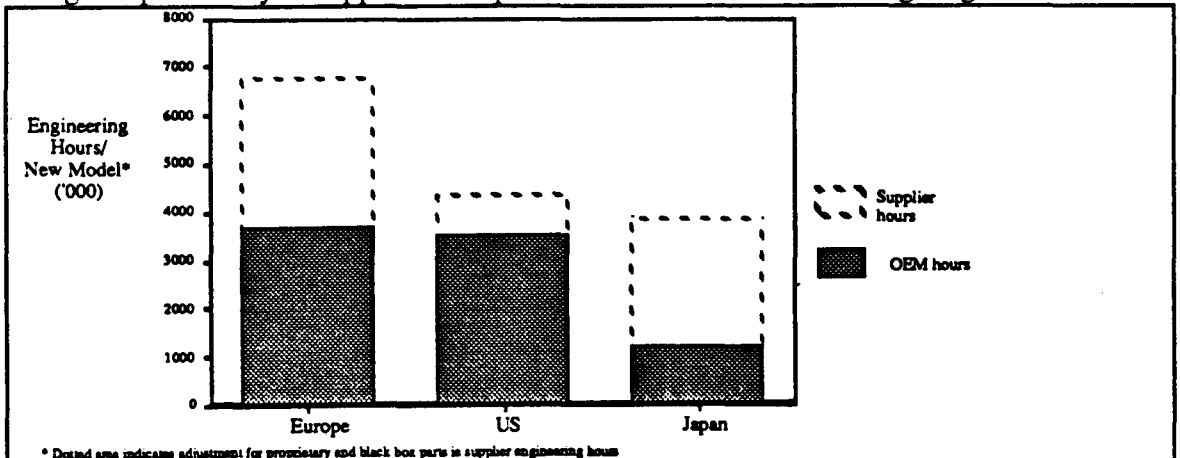


Source: Clark et al (1987)

Japanese vehicle producers have set ambitious goals to bring down further their development times during the 1990s, making it necessary for European producers to redouble their efforts if they are to significantly narrow the current gap.

This faster new product development capability, combined with flexible manufacturing systems that allow greater product variety without cost penalties, have resulted in Japanese sustaining much larger product variety. Among volume producers, Japanese vehicle manufacturers produce 70% more basic models (defined in terms of common platforms) per million units than European ones. These figures relate to their home market; the full competitive impact of the Japanese variety weapon has not yet been felt in Europe, given the long logistics pipeline from Japan to Europe. With rapid growth of Japanese transplant production in the EC during the 1990s, we would expect to see a much greater use of variety tailored to European consumers' needs, as has recently begun to occur with the US transplants.

Moreover, shorter model development cycles based on a fundamentally different process imply lower costs: Japanese OEMs expend less resources in new model development than EC vehicle manufacturers, measured in engineering hours. This difference is, according to studies led by K. Clark at Harvard, more than 3 1/2 times. However, Japanese product development is substantially more delegated to suppliers than in the EC. Two-thirds of product development in Japan is carried out by suppliers in the form of own or delegated "black box" design, whilst this proportion is around one-half in the EC. The gap in development productivity is, therefore, not wholly attributable to greater delegation of design responsibility to suppliers in Japan as illustrated in the following diagram:



* Dotted area indicates adjustment for proprietary and black box parts in supplier engineering hours

Source: Clark, BCG Interviews and Analysis

Combined vehicle and component manufacturers' development effort is 60% lower in Japan than in Europe per new model introduced. Such differences are not explained by a lower degree of design novelty (eg "face lifts" vs "new model"), since Japanese new models contain more unique (over 80%) and fewer common and carryover parts than US (with just over 60% unique parts) and EC competitors (with 70%). This links directly the fast model cycles of Japanese OEMs to requirements on their component suppliers for design cycle competitiveness.

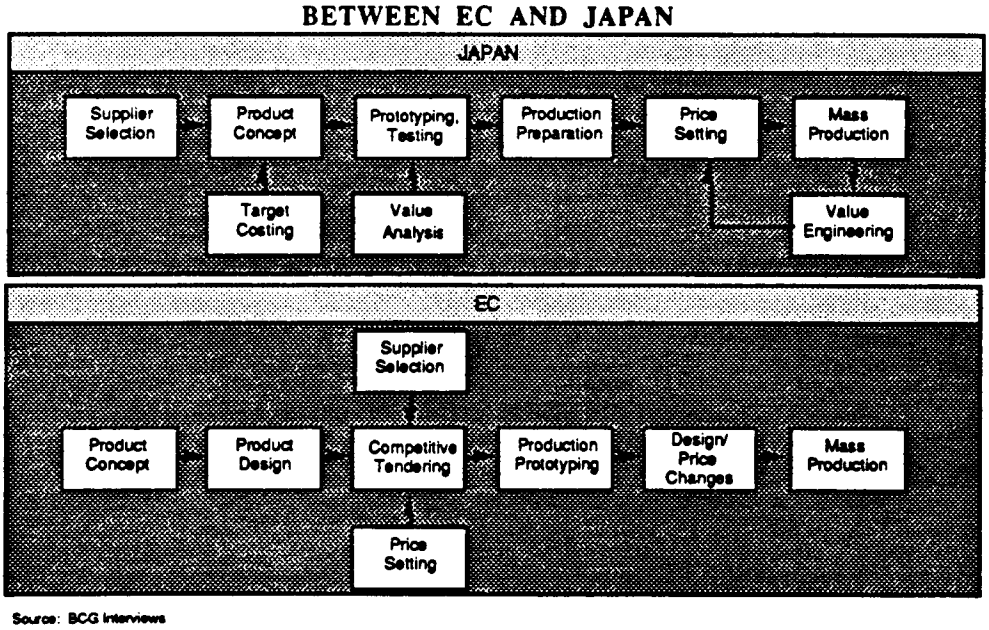
The above evidence indicates that the Japanese automotive and component industries achieve higher product development performance without spending more on R&D. This hypothesis is confirmed by analysing R&D expenditure in the automotive and components industries: the weighted average of combined OEM and component manufacturers' R&D expenditure in Japan was 3.5% of sales in 1988, compared to 4% in the EC, as was illustrated earlier in this executive summary.

The Development Process

The compression of product development cycles frequently requires a major reorganisation of the development process. Typical measures include the establishment of multifunctional development teams, co-location of development resources, establishment of competitive time bench-marks, parallel processing of key elements of development such as design, manufacturability, marketability etc., minimisation of interruptions, "invisible support functions" (approvals, tests etc.) , and clear goal definition for the development process. (see G Stalk/T Hout, Competing Against Time, Macmillan 1990).

In the automotive industry, successful product development is largely a function of how the division of labour between assemblers and component producers is approached in terms of the degree of delegation, and the nature of cooperation existing between car manufacturers and their suppliers. The following diagram depicts typical patterns of component development in Japan and the EC:

TYPICAL PATTERNS OF COMPONENT DEVELOPMENT DIFFER MARKEDLY BETWEEN EC AND JAPAN



Source: BCG interviews

The key characteristic of the *European model* of product development is that concept development and product design take place within the assembler and that supplier selection occurs subsequently based on competitive tendering largely on the basis of price. Then follows a phase of production prototyping including eventual design and price changes before final mass production.

The *Japanese model* is typically based on establishing a supplier relationship within which the product development process takes place: supplier selection occurs at the beginning of the development process. Product development is largely delegated to the component producer. During concept development, target costs are defined jointly. Prototyping, testing and production preparation are performed by the same supplier, maximising manufacturability and opportunities for parallel processing and time compression. Prices are only fixed once manufacturing aspects are duly taken into account.

The key difference between the European and Japanese models is that whereas the Japanese system appears to be based on underlying trust and cooperative attitudes, the European system is adversarial, reflected in competitive bidding and profitability differentials between suppliers and OEMs. The Japanese value chain shares costs and benefits, unlike in Europe (see above). The table below summarises key differences between the Japanese and European models of product development:

Item	EC	Japan
Supplier selection		
• Timing	Late (post design)	Early (concept stages)
• Criteria	Price, etc	Development ability, etc
• Number	Several per model	One per model
• Term	1-2 years	Model life
Design source		
• Identity	Frequently OEM	Frequently supplier (black box)
• Number	Several	One
Price/cost		
• Timing	Initial price fixed early	Price fixed late
• Method	Competitive tender	Target cost
• Stability	Price rises with design changes	Continuous cost reduction
• Openness	No exchange of cost information	Full exchange of cost information

Several advantages derive from the Japanese pattern of component development, the key ones being the following:

- Economies of scale and experience in component development
  - By delegating development to specialist suppliers
- Design for manufacture
  - Design source is always component manufacturer
  - Simultaneous (vs sequential in EC) optimisation of performance, cost and quality
- Elimination of duplicated development effort
  - Between OEM and supplier
  - Between suppliers
- Incentive for supplier investment in R&D
  - Supply ensured during model cycle time
  - Single sourcing per part
  - Single design source (= supplier)
- Collaborative cost reduction
  - Value analysis and engineering

- Transparency of cost information
- Shared benefits.

On the other hand, traditional European patterns of product development have discouraged investment and innovation , as reflected in the following representative comment of a major component producer: "We have frequently invested in development work and have not been awarded the supply contract or have only been given part of it. This has no net impact in market share terms but substantially reduces the efficiency of the overall supply system" . European companies are making attempts to gradually move towards a more "Japanese" pattern of product development. Examples are Ford through the expansion of the Q101 scheme which is planned to cover design, quality, delivery and managerial issues. BMW is attempting to delegate more development responsibility to suppliers, and various other European OEMs have plans to increase the development responsibility of their suppliers. Although these moves are encouraging, very rapid progress in improving the product development *process* between OEMs and component producers in Europe will be needed to close the gap with Japan, given their ambitious goals for further reductions in product development cycles.

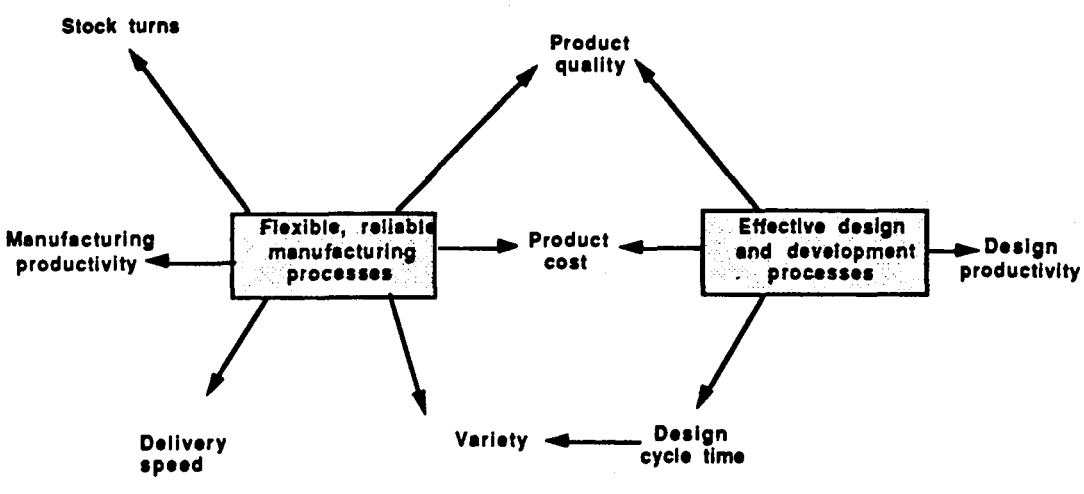
ACTIONS TO IMPROVE COMPETITIVENESS

Despite evidence of European excellence in a number of product areas in the automotive components industry, the EC industry is on the whole less competitive than the Japanese one by several measures. The Japanese autocomponent industry achieves:

- Higher labour productivity,
- Higher quality,
- Higher stock turns,
- Faster delivery cycles,
- Faster design and development cycles,
- Higher design and development productivity,
- Higher variety, and
- In many cases, lower product cost.

The EC industry critically requires to achieve improvements in its competitive position along all key competitive dimensions which are interrelated:

THE DIFFERENT DIMENSIONS OF COMPETITIVENESS ARE CLOSELY INTERRELATED



Detailed analyses indicated that the relatively poor competitive performance of the EC industry is not due to a lower level of capital investment, technological disadvantages or factor costs, but relates to lower operating efficiency in both manufacturing and product development. Action is required to improve operating capabilities and competitiveness within individual firms. Additionally, the industry will have to address issues relating to the relationship between companies and the overall industry structure.

The European industry has started to address the competitive challenge posed by the Japanese industry. The challenge is however major and its solution complex because actions and change have to occur at multiple levels. Actions are required at company, intercompany and industry levels.

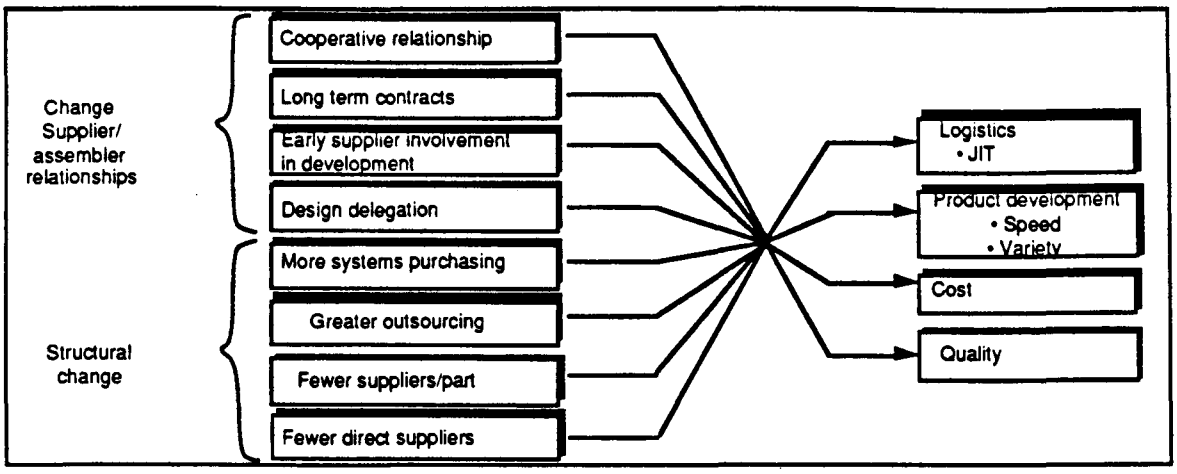
At the *company level*, enterprises must overcome the fragmentation of the different functions which is pervasive in most car companies in order to tackle supplier management issues. This requires the concerted effort of engineering, manufacturing and purchasing functions. At the component manufacturer level, management methods relating to JIT, decentralised responsibilities, shorter information loops and higher accuracy in manufacturing management are necessary to close the competitive gap. This requires major programmes for operational efficiency improvements and to build the capability of organisations to communicate and to coordinate without major indirect labour buildups.

At the *intercompany level*, it is necessary to increase trust and mutualism to ensure longer term relationships aiming to improve product performance and at the same time ensure appropriate levels of profitability along the value chain. The industry needs to consider increasingly the entire value chain as the key competitive unit, which implies a lower number of suppliers and increased mutual investment in supply relationships by vehicle manufacturers and suppliers. Shorter information loops coupled with a gradually increased use of Electronic Data Interchange (EDI) systems will be necessary in order to achieve synchronised production. Structural change towards fewer suppliers is necessary to achieve improvements, as pointed out above.

The speed and extent of reform in the relationship between OEMs and component producers is limited by obstacles at company, intercompany and industry levels. Obstacles at company level include labour inflexibilities and the limited frequency of model change in Europe, which reduces opportunities for radical reform. The rigid functional barriers that characterise many typical European automotive companies are an important obstacle since the nature of the required change transcends the traditional scope of OEM purchasing departments. Change needed is:

- radical rather than incremental,
- strategic rather than operational,
- requiring multifunctional/multidepartmental collaboration,
- inconsistent with low status often afforded to purchasing departments.

Intercompany level obstacles affect the prospects for change. Improving the competitiveness of the EC autocomponent industry requires fundamental changes in the nature and structure of the OEM/Supplier relationship:



Specifically, adversarial attitudes in the vertical chain are a severe handicap. The main obstacles are the unwillingness to incur risk through increased supplier/customer dependence. This leads to:

- intra rather than inter value chain rivalry,
- mutual distrust in relation to quality, delivery, loyalty, confidentiality, etc,
- lack of openness with information.

Furthermore, there is an absence of mechanisms for communication and cooperation between an OEM and its supplier base, such as are typical in Japan. These include supplier associations (grouping component suppliers to a given OEM), staff exchanges between personnel of OEMs and suppliers to facilitate transfer of experience and building of trust, and technical assistance programmes by the vehicle manufacturer to help suppliers adopt new manufacturing methods and improve productivity and quality.

Structural change is a crucial element to achieve improvements in competitiveness. EC OEMs use many more direct suppliers than Japanese OEMs. As shown earlier, European car companies have between 800 and 2000 direct suppliers, whilst Japanese OEMs have between 160 and 300. EC OEMs are gradually reducing their number of direct suppliers by reducing the number of suppliers per part and increasing the number of parts supplied by individual suppliers. It is estimated that OEMs will shift from currently half of their components supplied by 2 or more suppliers to a pattern of 80% of parts supplied by one or two companies only. Increased systems purchasing has started for more recent car models in Europe and smaller suppliers have been eliminated. Other indicators of change are supplier certification schemes, common suppliers across several countries etc. The planned reductions will undoubtedly improve the ability to manage supplier relationships, but the issue remains as to whether the anticipated changes will be sufficient.

In addition to a larger number of suppliers, EC car manufacturers typically have a higher degree of vertical integration than Japanese OEMs, particularly if component divisions and subsidiaries are taken into account. On average, value added as a percent of sales for European OEMs is 46% without component subsidiaries and 56% including them; in contrast Japanese OEMs account for only 36% of total value added (the effective level of integration in Japan may be somewhat higher given financial affiliation of a number of key suppliers).

In Europe, OEMs are gradually reducing vertical integration through the delegation of sub assemblies and increased systems purchasing, reexamination of the cost efficacy of internal manufacture, outsourcing where OEM technology has fallen behind and for parts with high labour content. Greater outsourcing would frequently imply systems purchasing, and facilitate improvements in supplier management on the part of the vehicle manufacturer.

Greater outsourcing is also likely to be connected to the delegation of more tasks to suppliers, notably in the area of product development. European vehicle manufacturers are also increasingly outsourcing component systems rather than individual components, currently mainly in the area of seats, bumpers, suspension modules, pre-filled clutch hydraulics, door panels etc. Increased outsourcing of systems is also likely to be connected with longer-term relationships than currently. Today, one year contracts are the dominant form. It is estimated that three year contracts may account for half the supplier relationships by the mid-nineties.

At the *industry level*, it is important to strengthen the institutions of the autocomponents industry, especially at the EC level to ensure effective cooperation with the vehicle industry institutions, to provide reliable information on the components industry and to ensure effective policy input at EC level. Industry level obstacles include a limited institutional basis for the coordination of the component industry at national and EC levels. The basis for cooperation between suppliers and vehicle manufacturers is currently weak. A lack of effective industry associations can represent a severe handicap in achieving required change.

The industry is confronted with major challenges which require an effective industry cooperation and representation at national and EC levels. The current institutional framework has several inadequacies. At national level the sector institutions often achieve incomplete coverage of the industry in terms of product groups and companies. Key segments of the industry are not represented in some EC countries. Services to members are relatively limited in the area of statistics, research, policy development and education. At EC level there has previously been a lack of comparable industry data on key parameters such as production, consumption and employment. Problems of inconsistency, incompleteness and quality pervade information relating to the industry. In particular, *trade data* on components as currently produced is inconsistent with production data and at EC level there are severe problems of aggregation and accuracy under the harmonised nomenclature. It is important that efforts are undertaken to improve the quality of trade data at the EC level, in order to monitor the industry closely in the future in the context of the Single Market.

The limited collaboration with vehicle manufacturers' bodies on issues of mutual importance such as restructuring of OEM/supplier relationships, trade policy etc., is problematic. There is a need to work on a common protocol for electronic data interchange to facilitate adoption of JIT logistics and ordering/invoicing between vehicle manufacturers and autocomponent suppliers. Policy input at EC level has been limited and has lacked cohesiveness.

In comparison, the Japanese components industry association (JAPIA) represents the Japanese autocomponents industry very effectively:

- Permanent premises and secretariat
- Separate from assemblers' association but in close cooperation
- Extensive statistical and informational activities on trade, production, employment, R&D, financial results, overseas investment
- Good industry coverage (~75% total production)
- Active discussion of policy issues.

The institutional framework needs to be strengthened to support efforts to improve industry competitiveness. The institutions of the sector should consider enhancing their capability to serve the component industry, to ensure comparable representativeness across countries, to address problems of information availability and comparability and to develop policy input and interface with EC institutions.

Actions are urgently needed to improve the EC industry's competitiveness. The following table summarises the main problems and possible solutions relating to competitiveness:

COMPETITIVENESS
Summary of main problems and possible solutions

Competitive gap with Japan		
• Cost, quality, product development	→	Education, awareness, attitudes
• OEM - supplier relationship at core of problem		Information dissemination
• Mutual interest of both parties to reform relationship		OEM supplier 'clubs'
Effective adoption of modern manufacturing processes		
• Management systems and processes		OEM assistance to suppliers
• Fast product development	→	Training of management and workforce
• Flexible manufacturing and JIT		Japanese joint ventures
Structure		
• Increased outsourcing		OEM led restructuring
• Systems sourcing	→	Supplier reconfiguration
• Reduced number of direct suppliers		
Institutional		
• Limited institutional support	→	Increased resources
• Inadequate information		Improved structures/interfaces

Compared to the main competitive threat of the 1990s - the Japanese, the EC automotive components industry has relatively low productivity, quality, and operating efficiency and is not improving at high enough rates to match Japanese industry performance. The gap is significant and needs to be closed. The speed of product development is a key competitive variable and Europe lags Japan significantly.

In order to close the competitive gap, in addition to entreprise specific programmes to effectively adopt modern, flexible manufacturing and new product development processes, there is a need for structural change towards fewer suppliers with enhanced systems capability, and changes in the OEM-supplier relationship.

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The Boston Consulting Group Limited

Devonshire House Mayfair Place London W1X 5FH

Telephone 01-753 5353 and 01-493 3222

Boston Chicago Düsseldorf London Los Angeles Madrid Milan
Munich New York Paris San Francisco Stockholm Tokyo Zurich